Science Applications
International Corporation
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SITE CHARACTERIZATION / CORRECTIVE ACTION PLAN

CHEMICAL LEAMAN TANK LINES, INC.
INSTITUTE, WEST VIRGINIA

PERMIT NUMBER WVR000001719

SAIC Project 01-1633-00-3973-207

Prepared for

Quality Distribution, Inc.
150 Pennsylvania Avenue; Suite 125
Downingtown, Pennsylvania 19335

May 2002

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PURPOSE AND SCOPE

On behalf of Quality Distribution, Inc. (QDI), Science Applications International Corporation (SAIC) conducted work at the former Chemical Leaman Tank Lines (CLTL) facility located in Institute, WV. The purpose of this work was to collect sufficient data to characterize the site in order to develop a corrective action plan. The completed work consisted of the installation ten groundwater monitoring wells, the installation and sampling of a background soil boring, groundwater sampling of all on-site monitoring wells, the evaluation of corrective action options, and the specification of a corrective action.

BACKGROUND

In the fall of 1995, a former disposal area which contained buried drums was discovered east of the current terminal building. The drums, along with soils that had been impacted with volatile organic compounds (VOCs) benzene, toluene, ethylbenzene, and xylene (BTEX) and semi-volatile organic compounds (SVOCs), were subsequently excavated. The area where the drum and soil excavation occurred was backfilled with compacted crushed stone and is currently utilized by QDI as a parking area. Some of the soils which were excavated as part of the drum removal were treated on-site using eight separate biocells. These biocells were successful in remediating the bulk of these soils to levels which met the West Virginia Department of Environmental Protection (DEP) Land Disposal Requirements (LDRs) for all Appendix IX constituents. Those soils which did not meet LDRs at the completion of the bioremediation were sent off-site for disposal.

In the fall of 1997, the biocells were disassembled and the successfully treated soils were stockpiled at the eastern end of the property. Both the former biocell area and the soil stockpile were compacted and contoured to promote runoff while minimizing potential erosion. The areas were then hydro-seeded with a mixture of winter wheat and perennial grass to allow for area revegetation and to preclude erosion.

Under the original facility permit, six groundwater monitoring wells (MW-101 through MW-106) were installed to characterize the groundwater around the waste management areas at the site. These six monitoring wells were installed on August 9 through 12, 1999, sampled on September 5, 1999, and analyzed for the parameters outlined in permit condition IV-C-2. The results of the sampling, summarized by SAIC in a report dated November 9, 1999; demonstrated that several compounds were detected in monitoring wells at concentrations above the groundwater protection standards listed in the permit. Based on the results of the initial groundwater sampling, the wells were sampled again on October 18 and 19, 1999 and analyzed for the list of constituents in Appendix IX of 40 CFR 264 as directed by the permit. The results of the Appendix IX sampling were summarized by SAIC in a report dated December 23, 1999. Based on the exceedance of the groundwater protection standards, a corrective action program is proposed herein.

In order to establish a corrective action program, additional information was collected to further define the hydrogeological characteristics. A modification to the facilities permit (Permit Modification #001) was granted by the DEP on May

11, 2000 and included the installation and monitoring of four additional groundwater monitoring wells and the completion of aquifer testing.

Since the original monitoring wells were installed in September 1999, monitoring wells MW-101 through MW-106 have been sampled nine times and monitoring wells MW-107 through MW-110 four times. The results of each sampling event have been transmitted to the DEP under separate cover. The most recent groundwater sampling event was completed in December 2000. Per the facility permit, the frequency of sampling events following the December 2000 sampling will be reduced to semi-annual.

The remainder of this report documents the results of the site characterization activities, proposes a corrective action, and provides a modification to the existing permit to complete the proposed corrective action.

SITE SETTING

Location and Topography

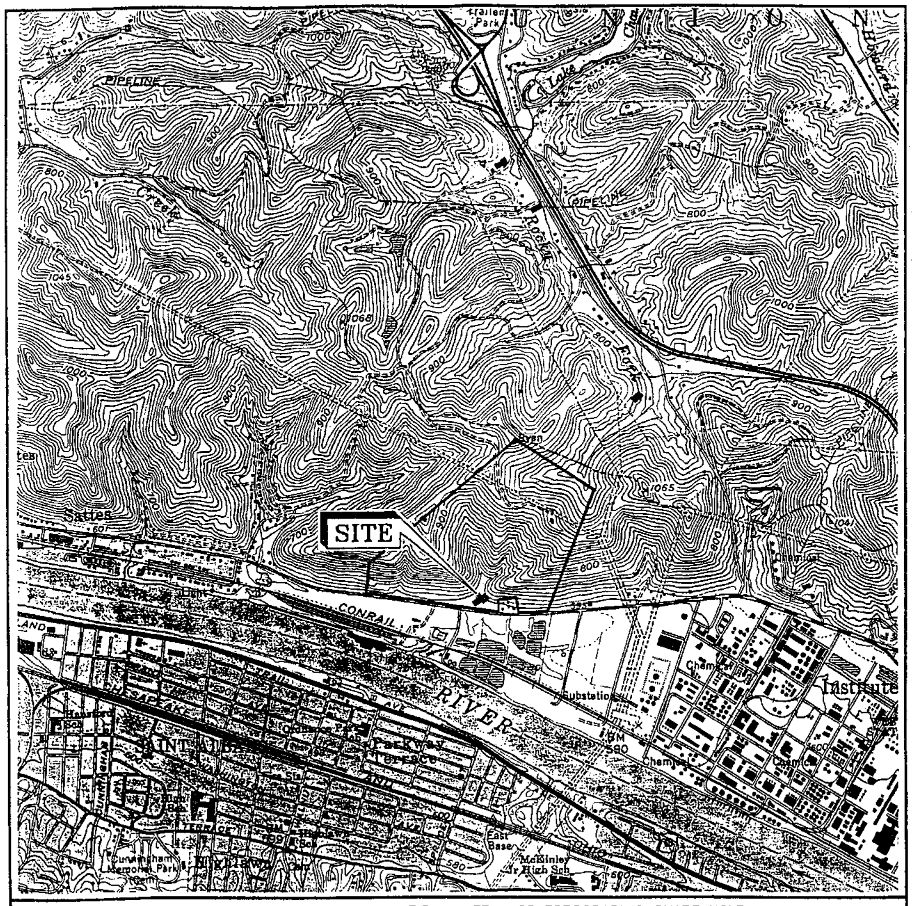
The site is located at 38° 23' 40" north latitude and 81° 47' 45" west longitude along Route 25 in Institute, West Virginia, approximately 4.5 miles west of Charleston and 1,200 feet north of the Kanawha River (Figure 1). The area of the site is an industrial area bounded by steep forested slopes. The site topography is sloped south at about a 5 percent gradient.

The topographic position of the site is on a terrace at the base of forested slopes, which rise steeply north from the site to over 1,000 feet above mean sea level (AMSL). South of the site is a flood plain area, which grades gradually to the Kanawha River at about 566 feet AMSL. The Aventis chemical manufacturing facility is located between the site and the Kanawha River (Figure 2). This plant is performing on-going groundwater remediation consisting of an array of groundwater extraction wells.

The site consists of 8.25 improved acres, and is elongated in an east/west direction. One large terminal building is present on-site, which consists of a QualaWash and the QDI facility (Figure 3). The former drum removal area is located east of the QualaWash facility building. The former soil bioremediation areas were located approximately 200 to 400 feet further east. The treated soil stockpile lies 600 to 700 feet east of the building.

Soils

The soils present at the site consist of silty and sandy clays that were formed partially from the weathering and downslope movement of the sandstone and shale bedrock. Kanawha River terrace deposits may also be present. Both mechanisms of deposition are capable of creating the stratified fine to coarse-grained soils observed on-site. Based on the drilling completed during the monitoring well installations, soil thickness on top of rock ranges from 20 to 30 feet.



NOTE: BASE MAP FROM THE SAINT ALBANS, W. VA, 7.5 MINUTE USGS TOPOGRAPHIC QUADRANGLE. (PHOTOREVISED 1971 AND 1976)

2000' 0 2000'
SCALE IN FEET

N

LEGEND

PROPERTY BOUNDARY

QUADRANGLE LOCATION

CHEMICAL LEAMAN TANK LINES, INC.			
INSTITUTE, W.VA			
SITE LOCATION MAP			
drawn RAM	checked MAL	approved	figure no.
date 01/13/98	date 1/14/98	date	1
job no. 01-1408-00-1140-000		file no. 01140-001-A	

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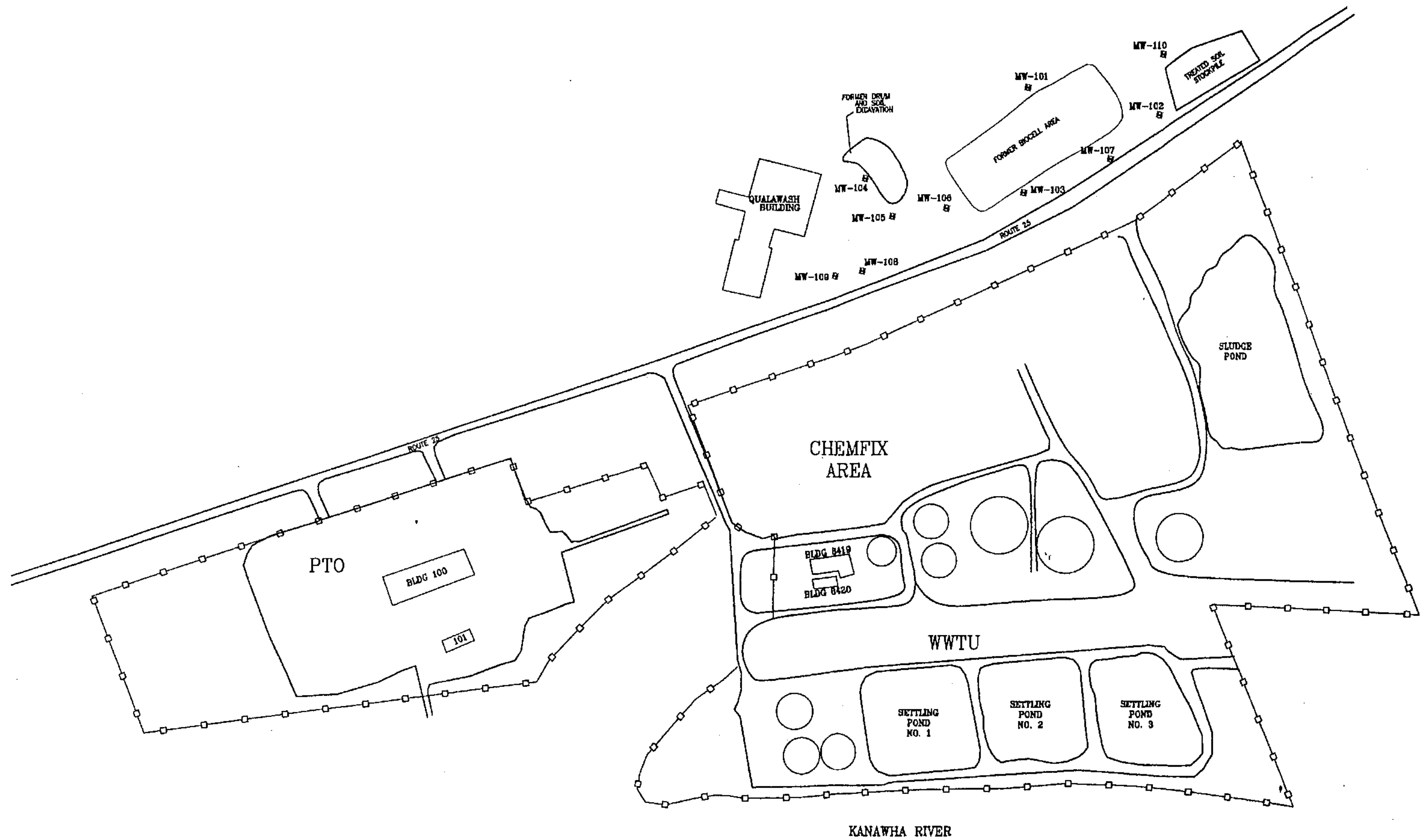

LEGEND

MW-101 CLTL MONITORING WELL LOCATION

N

250' 0 250'

SCALE IN FEET

NOTE: OFF-SITE FACILITY INFORMATION FROM A RHONE-POULENC GROUNDWATER MAP

QUALITY DISTRIBUTION, INC.
INSTITUTE, WEST VIRGINIA

EXPANDED SITE MAP

drawn ALK	checked	approved	figure no.
date 04/18/01	date	date	2
job no. 01-1633-00-3973-207		file no. 03973-12	

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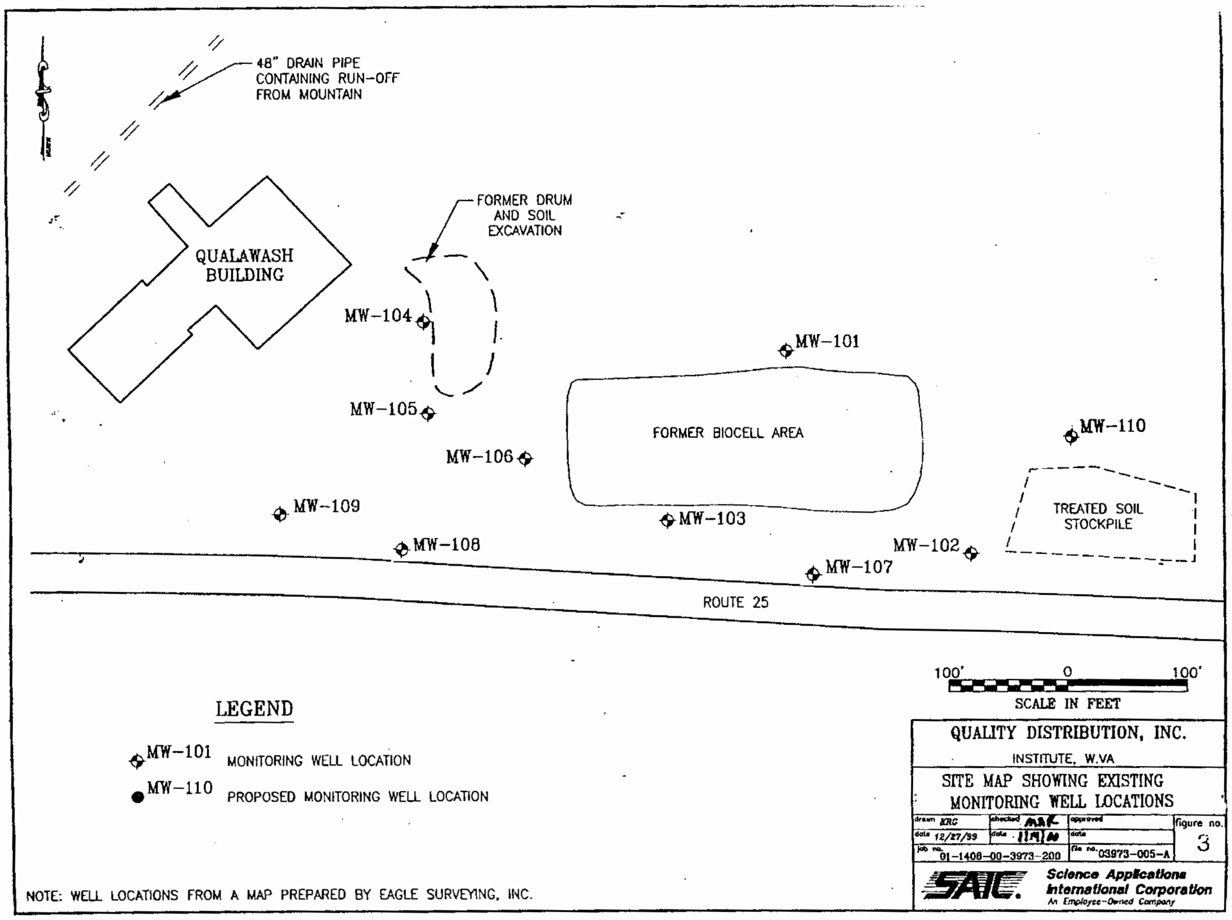

48" DRAIN PIPE CONTAINING RUN-OFF FROM MOUNTAIN
FORMER DRUM AND SOIL EXCAVATION
QUALAWASH BUILDING
MW-104
MW-105
MW-106
MW-101
FORMER BIOCELL AREA
MW-110
TREATED SOIL STOCKPILE
MW-109
MW-108
MW-103
MW-102
MW-107
ROUTE 25
100'
0
100'
SCALE IN FEET
LEGEND
MW-101 MONITORING WELL LOCATION
MW-110 PROPOSED MONITORING WELL LOCATION
QUALITY DISTRIBUTION, INC.
INSTITUTE, W.VA
SITE MAP SHOWING EXISTING MONITORING WELL LOCATIONS
drawn KRG
date 12/27/99
job no. 01-1408-00-3973-200
file no. 03973-005-A
figure no. 3
SAIC
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NOTE: WELL LOCATIONS FROM A MAP PREPARED BY EAGLE SURVEYING, INC.

Soil Parameters

During the installation of the four additional groundwater monitoring wells in July 2000, soil samples were collected from the soil/groundwater interface to determine the porosity and bulk density. The results of these tests are summarized in Table 1 and copies of the testing reports included in Appendix A. Results indicate that the porosity of the soils range from 29.8% to 35.9% and soil density ranges from 1.73 grams per cubic centimeter (g/cm^3) to 1.86 g/cm^3. These porosity and density measurements are typical to the silty and sandy clays present at the site.

In July 2000, a soil boring was installed immediately adjacent to MW-101 to determine the amount of organic carbon present within background soils. The soil boring was advanced to the soil/groundwater interface with a soil sample collected one foot above this interface. The soil sample was analyzed for total organic carbon using EPA Method 600. The results of the soil analysis are included in Appendix A and demonstrated that background soils at the site contain 3.5% organic carbon.

Geology

The portion of West Virginia in which the site is located is part of the unglaciated Appalachian Plateau Physiographic Area. The bedrock on-site is comprised of the Kanawha formation of the Pottsville Group. This rock unit is composed of alternating beds of siltstone, sandstone, and shale commonly containing plant debris, coal, and, occasionally, thin limestone beds. The bedrock is resistant to weathering and has a well developed blocky fracture pattern, which has moderate porosity and permeability. The well logs for all of the monitoring wells installed on site are included as Appendix B.

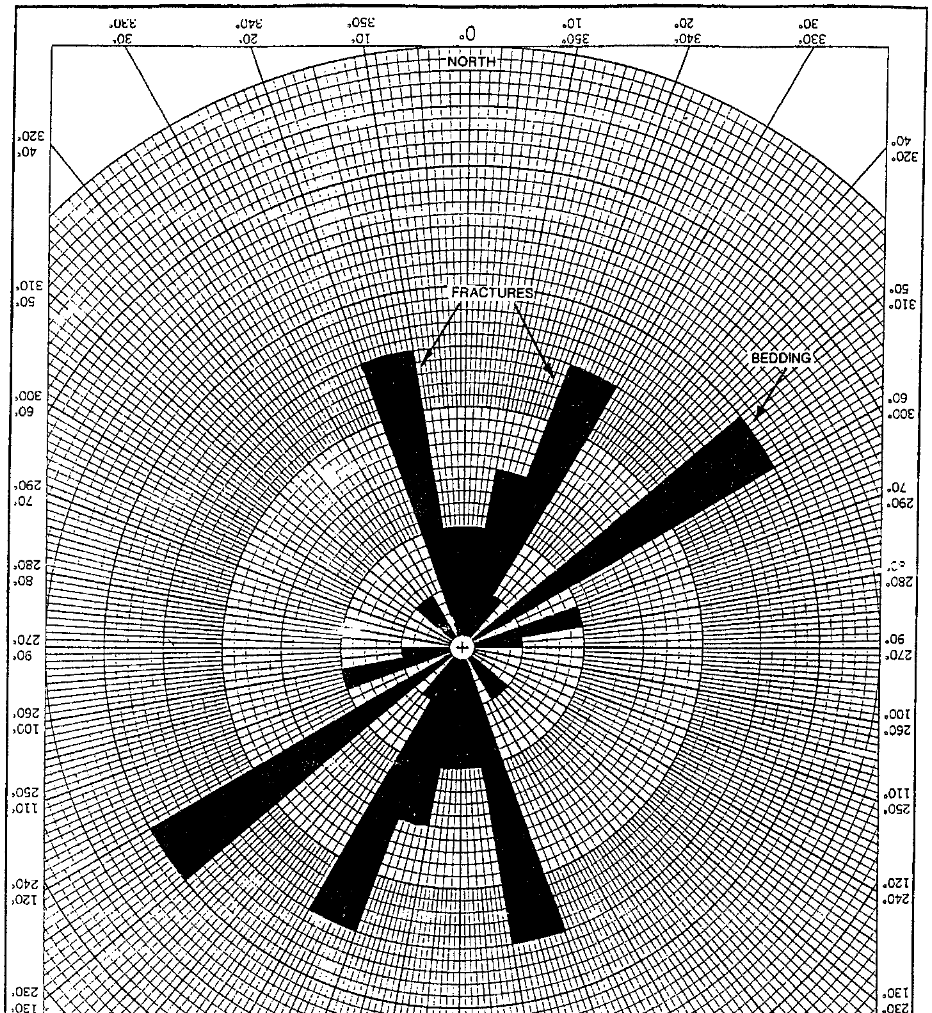
The structure of the bedrock was measured in outcrops on-site to observe the patterns of both bedding and fractures, which influence soil depth and fluid flow in bedrock. A polar plot (Figure 4) illustrates fracture orientation and relative degree of development, suggested by frequency of the measurements. The relative importance of fracture sets is indicated on the plot by a radial scale. The bedding strike (intersection of bedding plane with the horizontal) was measured to be generally north 55 degrees east with a dip of 2 degrees to 13 degrees south. Two main fracture trends were measured: north 2 to 32 degrees east and north 10 to 20 degrees west. Both fracture sets were nearly vertical. A review of linear fracture traces on aerial photographs confirmed the on-site measurements.

Table 1

Quality Distribution Facility- Institute, WV
Soil Property Analytical Data
Permit Number: WVR000001719

Soil Sample Location	Volume of Air (cubic cm)	Porosity (%)	Bulk Density (grams/cubic cm)
MW-107 (7-9.5')	66.2	31.0	1.86
MW-108 (9-11.5')	108.2	32.7	1.82
MW-109 (15-17.5')	72.9	35.9	1.73
MW-110 (20-22.5')	49.6	29.8	1.86
Site Average	74.2	32.4	1.82

Soil analysis from shelby tubes pushed during the well installation in July 2000



CHEMICAL LEAMAN TANK LINES, INC.
INSTITUTE, W.VA

BEDROCK ROSE DIAGRAM

drawn RAM	checked MAZ	approved	figure no.
date 01/14/98	date 1/14/98	date	4
job no. 01-1408-00-1140-000	file no. 01140-003-A		

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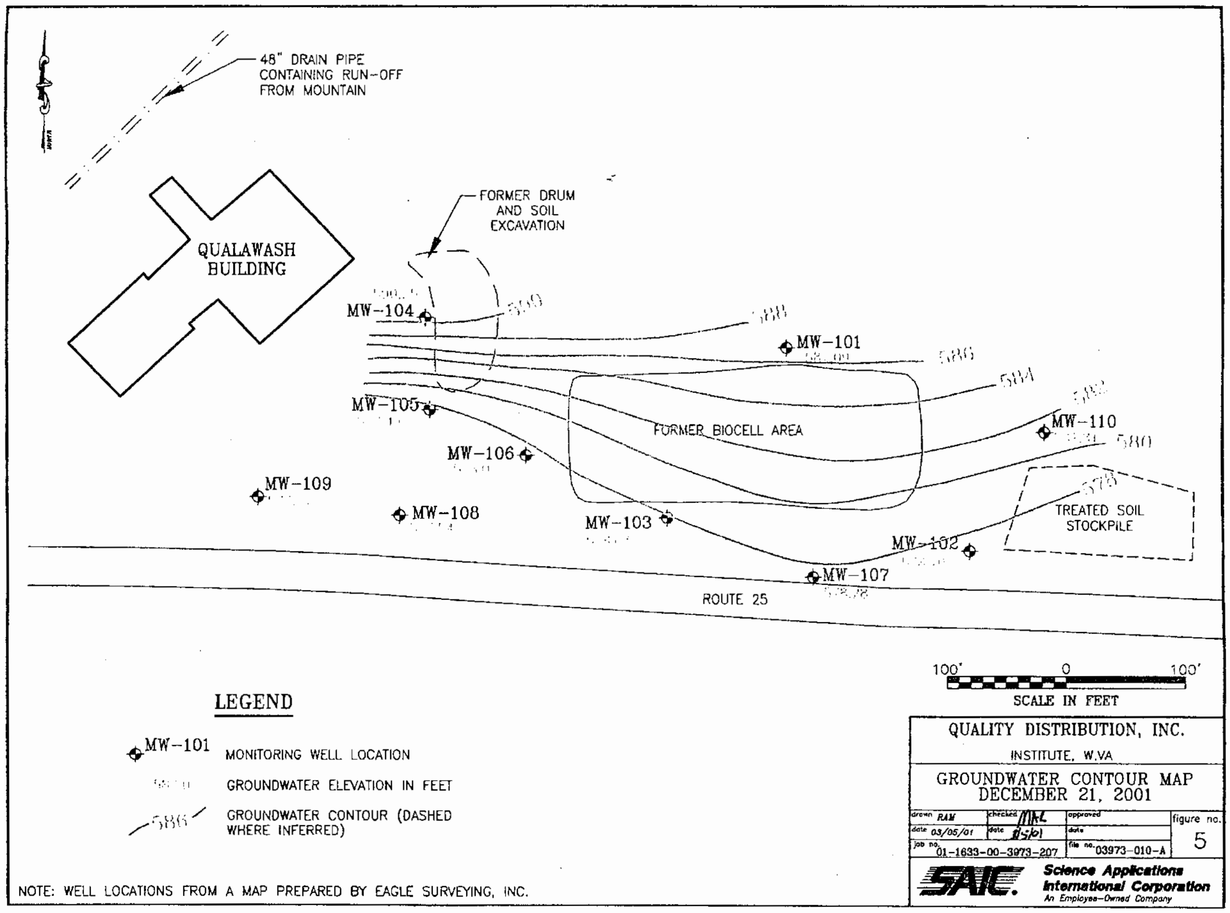
Topography, soil stratification, and bedrock fracturing are expected to control groundwater occurrence and flow. Generally, groundwater flow mimics topographic slope unless directed by the structure at the soil bedrock interface, bedrock fractures, or soil stratification. Fractures are the presumed main conduit for groundwater flow in bedrock, and to guide groundwater flow on the soil/bedrock interface. Soil formed by downslope movement tends to promote stratification, which inclines in the direction of movement. Groundwater beneath the site is present within the soils at depths ranging from 7 to 22 feet below grade (Table 2). Bedrock is present at depths ranging from 20 to 30 feet below grade. Due to the topography, soil stratification, and slope of the surface and fracture orientation; groundwater flow beneath the site is generally to the south, toward the Kanawha River (Figure 5).

Table 2
Quality Distribution Facility- Institute, WV
Monitoring Well Groundwater Level Elevations
Permit Number: WVR000001719

Location	Measurement Date	Top of PVC Casing Elevation (feet)	Depth to Groundwater (feet)	Groundwater Elevation (feet)
MW-101	9/5/1999	603.88	16.09	587.79
	10/18/1999	603.88	15.77	588.11
	12/27/1999	603.88	13.58	590.30
	3/28/00	603.88	11.93	591.95
	6/29/00	603.88	13.69	590.19
	9/28/00	603.88	16.51	587.37
	12/21/00	603.88	16.79	587.09
	6/25/01	603.88	16.79	587.09
	12/13/01	603.88	18.20	585.68
MW-102	9/5/1999	598.90	20.11	578.79
	10/18/1999	598.90	20.21	578.69
	12/27/1999	598.90	19.91	578.99
	3/28/00	598.90	19.26	579.64
	6/29/00	598.90	22.30	576.60
	9/28/00	598.90	20.00	578.90
	12/21/00	598.90	20.20	578.70
	6/25/01	598.90	19.25	579.65
	12/13/01	598.90	19.86	579.04
MW-103	9/5/1999	600.98	23.66	577.32
	10/18/1999	600.98	22.86	578.12
	12/27/1999	600.98	22.55	578.43
	3/28/00	600.98	21.98	579.00
	6/29/00	600.98	19.68	581.30
	9/28/00	600.98	22.52	578.46
	12/21/00	600.98	22.95	578.03
	6/25/01	600.98	21.78	579.20
	12/13/01	600.98	22.78	578.20
MW-104	9/5/1999	600.75	9.03	591.72
	10/18/1999	600.75	9.30	591.45
	12/27/1999	600.75	8.09	592.66
	3/28/00	600.75	6.65	594.10
	6/29/00	600.75	22.20	578.55
	9/28/00	600.75	8.50	592.25
	12/21/00	600.75	10.50	590.25
	6/25/01	600.75	7.42	593.33
	12/13/01	600.75	10.81	589.94
MW-105	9/5/1999	598.51	20.30	578.21
	10/18/1999	598.51	21.16	577.35
	12/27/1999	598.51	19.85	578.66
	3/28/00	598.51	19.15	579.36
	6/28/00	598.51	19.82	578.69
	9/26/00	598.51	20.45	578.06
	12/21/00	598.51	20.51	578.00
	6/25/01	598.51	19.55	578.96
	12/13/01	598.51	20.23	578.28
MW-106	9/5/1999	598.92	20.75	578.17
	10/18/1999	598.92	20.94	577.98
	12/27/99	598.92	19.90	579.02
	3/28/00	598.92	19.70	579.22
	6/29/00	598.92	20.26	578.66
	9/28/00	598.92	20.74	578.18
	12/21/00	598.92	20.90	578.02
	6/25/01	598.92	19.75	579.17
	12/13/01	598.92	20.72	578.20
MW-107	9/28/2000	588.83	10.00	578.83
	12/21/00	588.83	10.55	578.28
	6/25/01	588.83	9.50	579.33
	12/13/01	588.83	10.21	578.62
MW-108	9/28/2000	593.80	16.13	577.67
	12/21/00	593.80	16.26	577.54
	6/25/01	593.80	15.28	578.52
	12/13/01	593.80	16.00	577.80
MW-109	9/28/2000	597.37	19.93	577.44
	12/21/00	597.37	20.10	577.27
	6/25/01	597.37	19.12	578.25
	12/13/01	597.37	19.89	577.48
MW-110	9/28/2000	604.38	21.62	582.76
	12/21/00	604.38	22.57	581.81
	6/25/01	604.38	21.49	582.89
	12/13/01	604.38	22.55	581.83



48" DRAIN PIPE CONTAINING RUN-OFF FROM MOUNTAIN
QUALAWASH BUILDING
FORMER DRUM AND SOIL EXCAVATION
MW-104
MW-101
MW-105
MW-106
MW-109
MW-108
MW-103
MW-110
MW-102
MW-107
588
586
584
580
578
FORMER BIOCELL AREA
TREATED SOIL STOCKPILE
ROUTE 25
100' 0 100'
SCALE IN FEET
LEGEND
MW-101 MONITORING WELL LOCATION
GROUNDWATER ELEVATION IN FEET
586 GROUNDWATER CONTOUR (DASHED WHERE INFERRED)
NOTE: WELL LOCATIONS FROM A MAP PREPARED BY EAGLE SURVEYING, INC.
QUALITY DISTRIBUTION, INC.
INSTITUTE, W.VA
GROUNDWATER CONTOUR MAP
DECEMBER 21, 2001
drawn RAM
checked MKL
approved
figure no. 5
date 03/05/01
job no. 01-1633-00-3973-207
file no. 03973-010-A
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SOIL AND GROUNDWATER QUALITY

Soil Quality

During previous characterization and remediation activities, both the subsurface and surface soils on site have been eliminated as potential source areas. All sampled soils during these activities complied with state and federal land disposal restrictions (LDR's). All reports documenting soil characterization, remediation, and closure have been sent to DEP under separate cover.

Groundwater Quality

Groundwater has been sampled quarterly from each on-site monitoring well since the well was installed. Per the facilities permit the following groundwater analysis are required during groundwater monitoring events; pH, TOC, conductivity, total lead, benzene, carbon tetrachloride, chlorobenzene, dichlorobenzene-para, dichlorobenzene-ortho/meta, 1,2-dichloroethane, 1,1-dichloroethylene, methylene chloride, bis (2-ethylhexyl) phthalate, ethylbenzene, styrene, tetrachloroethylene, trichlorobenzene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethylene, and vinyl chloride. The original six groundwater monitoring wells installed in August 1999 (MW-101 through MW-106) have been sampled nine times while the four wells installed in July 2000 (MW-107 through MW-110) have been sampled four times. The results of each groundwater sampling event have been transmitted to the DEP under separate cover with the exception of the December 2000 sampling which is included herein as Appendix C. The December 2000 sampling results were consistent with the previous sampling in September 2000. During each groundwater monitoring event, groundwater samples were analyzed for indicator parameters (TOC, nitrate-nitrogen, sulfate, ferrous iron, pH, dissolved oxygen, specific conductance, and temperature), volatile organic compounds (VOC's) using EPA method 8260B, and semivolatile organic compounds (SVOC's) using EPA method 8270.

To date, nine permitted compounds [vinyl chloride, 1,2-dichloroethane, trichloroethene, 1,1,2-trichloroethane, benzene, tetrachloroethene, chlorobenzene, 1,4-dichlorobenzene, bis (2-ethylhexyl) phthalate] have been detected within at least one monitoring well at a concentration which exceeds the West Virginia Groundwater Protection Act (Appendix A of Title 46, Series 12). Collectively these compounds have been designated the site chemicals of concern (COC's).

Tables 3, 4, and 5 summarize the results of the groundwater analyses completed to date. Analytical results demonstrate that the greatest VOC and SVOC concentrations are in the vicinity of the former drum and soil excavation areas. This observation is expected since releases from the buried drums were the source of the compounds to the subsurface. Generally, the detected compounds present within the groundwater have been stable over time. This situation is expected with the removal of the sources (buried drums and contaminated soils) in 1996.

Concentrations of all permitted compounds decrease with distance from the source area to levels which are below the West Virginia groundwater protection standard at the downgradient property boundary. In evaluating the site for corrective action, the downgradient property boundary is considered the compliance point.

Table 3

Quality Distribution Facility- Institute, WV
Monitoring Well Groundwater Microbial Indicator Parameters
Permit Number: WVR000001719

Unless otherwise noted, all units are in micrograms per liter (ug/l)

						Field Measurements				
Location	Sample Date	Total Organic Carbon	Nitrate-Nitrogen	Sulfate	Ferrous Iron	Depth to Water (feet below toc)	pH (standard units)	Dissolved Oxygen (mg/l)	Specific Conductance (umhos)	Temperature (degrees C)
MW-101	9/5/1999	1,200	NA	NA	NA	18.09	6.98	NA	663	17.2
	10/18/1999	1,900	NA	NA	NA	15.77	7.37	NA	826	17.7
	12/27/1999	2,100	NA	NA	NA	13.58	7.50	NA	826	14.2
	3/28/00	22,000	NA	NA	NA	11.83	7.55	NA	749	13.2
	6/29/00	1,200	NA	NA	NA	13.69	7.40	NA	626	12.3
	9/26/00	2,200	270	75,000	NA	18.51	6.80	5.40	540	15.8
	12/21/00	1,000	220	64,000	ND (<1,000)	16.79	6.45	3.90	420	15.0
	6/25/01	1,500	350	87,000	ND (<1,000)	16.79	7.63	2.70	430	18.3
	12/13/01	5,400	220	53,000	ND (<1,000)	18.20	7.21	4.00	816	15.7
MW-102	9/5/1999	7,400	NA	NA	NA	20.11	7.06	NA	990	17.3
	10/19/1999	7,000	NA	NA	NA	20.21	6.29	NA	1,029	14.5
	12/27/1999	6,500	NA	NA	NA	19.91	7.20	NA	1,030	12.1
	3/28/00	30,000	NA	NA	NA	19.26	7.08	NA	922	14.1
	6/29/00	5,200	NA	NA	NA	22.30	6.95	NA	543	13.8
	9/26/00	4,200	240	120,000	NA	20.00	6.30	6.10	750	16.1
	12/21/00	4,900	91	120,000	ND (<1,000)	20.20	6.39	1.90	400	14.4
	6/25/01	2,800	170	140,000	ND (<1,000)	19.25	7.20	6.60	382	17.3
	12/13/01	13,000	84	110,000	ND (<1,000)	19.86	6.68	3.10	1,166	15.3
MW-103	9/5/1999	9,100	NA	NA	NA	23.66	7.07	NA	779	16.1
	10/19/1999	4,300	NA	NA	NA	22.86	6.30	NA	935	14.1
	12/27/1999	5,600	NA	NA	NA	22.56	6.90	NA	890	15.2
	3/28/00	23,000	NA	NA	NA	21.98	7.19	NA	655	14.5
	6/29/00	2,200	NA	NA	NA	19.68	7.04	NA	696	12.6
	9/26/00	4,200	530	81,000	NA	22.52	6.05	6.40	416	17.5
	12/21/00	2,600	800	64,000	ND (<1,000)	22.95	6.10	6.30	412	14.4
	6/25/01	2,200	1,100	58,000	ND (<1,000)	21.78	7.30	7.50	360	18.1
	12/13/01	4,600	790	54,000	ND (<1,000)	22.78	6.20	6.40	530	15.3
MW-104	9/5/1999	46,000	NA	NA	NA	9.03	7.25	NA	1,220	18.2
	10/18/1999	47,000	NA	NA	NA	9.30	6.85	NA	1,181	16.2
	12/27/1999	53,000	NA	NA	NA	8.09	6.84	NA	1,237	17.0
	3/28/00	88,000	NA	NA	NA	6.65	7.24	NA	844	14.2
	6/29/00	170,000	NA	NA	NA	22.20	7.43	NA	813	14.6
	9/26/00	87,000	ND (<50)	5,000	NA	8.50	6.63	2.10	749	18.2
	12/21/00	51,000	76	13,000	ND (<1,000)	10.50	7.25	3.10	420	16.3
	6/25/01	36,000	55	1,800	2,700	7.42	6.65	ND (<0.50)	695	19.4
	12/13/01	45,000	2,400	75,000	ND (<1,000)	10.81	6.87	ND (<0.50)	805	17.9
MW-105	9/5/1999	130,000	NA	NA	NA	20.30	7.24	NA	1,430	16.6
	10/18/1999	89,000	NA	NA	NA	21.16	6.69	NA	1,376	15.5
	12/27/1999	65,000	NA	NA	NA	19.85	7.05	NA	1,220	13.8
	3/28/00	83,000	NA	NA	NA	19.15	7.65	NA	856	15.1
	6/29/00	78,000	NA	NA	NA	19.82	6.85	NA	627	12.1
	9/26/00	26,000	ND (<50)	18,000	NA	20.45	6.80	2.80	682	16.3
	12/21/00	20,000	78	3,500	ND (<1,000)	20.51	6.19	0.97	345	15.1
	6/25/01	29,000	54	2,100	20,000	19.55	6.90	ND (<0.50)	420	17.9
	12/13/01	32,000	ND (<50)	2,500	9,500	20.23	6.80	ND (<0.50)	1,050	15.9
MW-106	9/5/1999	14,000	NA	NA	NA	20.75	7.13	NA	1,250	16.9
	10/18/1999	10,000	NA	NA	NA	20.94	6.90	NA	1,294	15.2
	12/27/99	12,000	ND (<50)	NA	NA	19.90	7.19	NA	1,312	12.7
	3/28/00	52,000	NA	NA	NA	19.70	7.34	NA	917	15.2
	6/29/00	28,000	NA	NA	NA	20.26	6.90	NA	673	11.3
	9/26/00	12,000	ND (<50)	16,000	NA	20.74	6.55	2.80	911	15.6
	12/21/00	15,000	ND (<50)	14,000	ND (<1,000)	20.90	6.39	ND (<0.50)	470	14.4
	6/25/01	12,000	ND (<50)	17,000	ND (<1,000)	19.75	6.96	ND (<0.50)	406	18.7
	12/13/01	20,000	ND (<50)	14,000	6,900	20.72	6.70	2.90	1,390	15.3
MW-107	9/26/2000	3,100	ND (<50)	130,000	NA	10.00	5.82	2.70	674	18.0
	12/21/00	5,900	55	130,000	ND (<1,000)	10.55	6.01	1.50	355	15.0
	6/25/01	5,200	21	140,000	ND (<1,000)	9.60	6.88	0.69	335	18.3
	12/13/01	19,000	ND (<50)	100,000	ND (<1,000)	10.21	6.45	1.80	1,107	16.6
MW-108	9/26/2000	3,200	ND (<50)	180,000	NA	16.13	6.30	3.10	532	15.9
	12/21/00	3,300	ND (<50)	150,000	ND (<1,000)	16.62	6.20	1.50	400	15.3
	6/25/01	4,000	ND (<50)	160,000	ND (<1,000)	15.28	6.60	0.62	410	19.6
	12/13/01	5,500	ND (<50)	150,000	ND (<1,000)	16.00	6.25	2.00	897	15.8
MW-109	9/26/2000	3,000	ND (<50)	140,000	NA	19.93	6.30	3.20	484	16.8
	12/21/00	3,400	ND (<50)	160,000	ND (<1,000)	20.10	6.47	1.20	400	15.7
	6/25/01	3,900	ND (<50)	140,000	ND (<1,000)	19.12	6.83	0.65	411	18.6
	12/13/01	8,300	0.069	130,000	ND (<1,000)	19.89	6.30	2.90	671	16.4
MW-110	9/26/2000	7,100	ND (<50)	130,000	NA	21.62	6.49	6.60	583	14.3
	12/21/00	4,100	ND (<50)	33,000	ND (<1,000)	22.57	6.35	1.10	425	15.1
	6/25/01	2,400	320	73,000	ND (<1,000)	21.49	6.26	2.70	410	18.3
	12/13/01	21,000	ND (<50)	46,000	ND (<1,000)	22.55	7.00	2.00	888	14.9
West Virginia Groundwater Protection Standard (Title 46, Series 12, Appendix A)		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A: There is no established West Virginia groundwater protection standard per Title 46, Series 12 Appendix A
NA: Compound was not analyzed during the sampling event

Table 4

Quality Distribution Facility- Institute, WV
Monitoring Well VOC Groundwater Analytical Data
Permit Number: WVR000001719

Unless otherwise noted, all units are in micrograms per liter (ug/l)

Location	Sample Date	Volatile Organic Compounds by EPA 8260: Vinyl chloride	1,1-Dichloroethene	1,2-Dichloroethane	Trichloroethene	1,1,2-Trichloroethane	Benzene	Tetrachloroethene	Chlorobenzene	Ethylbenzene
MW-101	8/5/1999	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	10/18/1999	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	12/27/99	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	3/28/00	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	6/28/00	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)
	9/26/00	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)
	12/21/00	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	29	ND(<5)
	6/25/01	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	140	5.8
	12/13/01	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)
MW-102	8/5/1999	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	10/18/1999	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	12/27/1999	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	3/28/00	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	6/28/00	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)
	9/26/00	ND(<5)	ND(<5)	7.7	ND(<5)	ND(<5)	ND(<5)	ND(<5)	58	ND(<5)
	12/21/00	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	130	6.8
	6/25/01	ND(<5)	ND(<5)	8.4	ND(<5)	ND(<5)	ND(<5)	ND(<5)	230	11
	12/13/01	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)
MW-103	8/5/1999	29	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	10/19/1999	11	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	12/27/1999	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	3/28/00	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	6/28/00	ND(<5)	ND(<5)	21	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)
	9/26/00	ND(<5)	ND(<5)	ND (<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	72	ND(<5)
	12/21/00	ND(<5)	ND(<5)	ND (<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	24	ND(<5)
	6/25/01	ND(<5)	ND(<5)	ND (<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	130	7.2
	12/13/01	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)
MW-104	8/5/1999	6.8	ND (<5)	ND (<5)	77	ND (<5)	180	ND (<5)	18,000	820
	10/18/1999	ND (<500)	ND (<500)	ND (<500)	ND (<500)	ND (<500)	ND (<500)	ND (<500)	18,000	810
	12/27/1999	ND (<500)	ND (<500)	ND (<500)	ND (<500)	ND (<500)	ND (<500)	ND (<500)	18,000	730
	3/28/00	24	ND (<5)	ND (<5)	54	ND (<5)	54	ND (<5)	8,000	380
	6/28/00	ND(<100)	ND(<100)	ND(<100)	ND(<100)	ND(<100)	ND(<100)	ND(<100)	8,600	400
	9/26/00	ND (<1,000)	ND (<1,000)	ND (<1,000)	ND (<1,000)	ND (<1,000)	ND (<1,000)	ND (<1,000)	31,000	ND (<1,000)
	12/21/00	ND (<1,000)	ND (<1,000)	ND (<1,000)	ND (<1,000)	ND (<1,000)	ND (<1,000)	ND (<1,000)	21,000	ND (<1,000)
	6/25/01	ND (<1,000)	ND (<1,000)	ND (<1,000)	ND (<1,000)	ND (<1,000)	ND (<1,000)	ND (<1,000)	32,000	ND (<1,000)
	12/13/01	ND (<500)	ND (<500)	ND (<500)	ND (<500)	ND (<500)	ND (<500)	ND (<500)	19,000	ND (<500)
MW-105	8/5/1999	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	6.8	ND (<5)	ND (<5)	ND (<5)
	10/18/1999	ND (<50)	ND (<50)	ND (<50)	ND (<50)	ND (<50)	ND (<50)	ND (<50)	580	ND (<50)
	12/27/1999	ND (<50)	ND (<50)	ND (<50)	ND (<50)	ND (<50)	ND (<50)	ND (<50)	ND (<50)	ND (<50)
	3/28/00	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	6/28/00	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)
	9/26/00	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	270	13
	12/21/00	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	12	ND(<5)
	6/25/01	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	870	26
	12/13/01	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)
MW-106	8/5/1999	40	8.7	35	330	83	75	19	1,400	ND (<5)
	10/18/1999	ND (<50)	ND (<50)	ND (<50)	ND (<50)	ND (<50)	66	370	1,400	ND (<50)
	12/27/1999	ND (<50)	ND (<50)	ND (<50)	370	66	74	ND (<50)	1,200	ND (<50)
	3/28/00	26	8.2	29	340	66	58	7.8	1,500	ND (<5)
	6/28/00	ND(<50)	ND(<50)	56	380	74	87	ND(<50)	1,400	ND(<50)
	9/26/00	ND(<50)	ND(<50)	ND (<50)	400	83	75	ND(<50)	1,700	ND(<50)
	12/21/00	ND(<50)	ND(<50)	ND (<50)	370	79	83	ND(<50)	1,800	ND(<50)
	6/25/01	ND(<50)	ND(<50)	ND (<50)	300	66	87	ND(<50)	1,600	ND(<50)
	12/13/01	48	ND(<25)	170	360	78	81	ND(<25)	1,700	ND(<25)
MW-107	9/26/2000	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	32	ND(<5)
	12/21/00	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	13	ND(<5)
	6/25/01	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	72	ND(<5)
	12/13/01	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)
MW-108	9/26/2000	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	82	ND(<5)
	12/21/00	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	12	5.8
	6/25/01	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	810	33
	12/13/01	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)
MW-109	9/26/2000	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	200	8.8
	12/21/00	ND(<25)	ND(<25)	ND(<25)	ND(<25)	ND(<25)	ND(<25)	ND(<25)	210	ND (<25)
	6/25/01	ND(<25)	ND(<25)	ND(<25)	ND(<25)	ND(<25)	ND(<25)	ND(<25)	310	ND (<25)
	12/13/01	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)
MW-110	9/26/2000	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	80	ND(<5)
	12/21/00	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	36	ND(<5)
	6/25/01	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	240	8.8
	12/13/01	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)
West Virginia Groundwater Protection Standard (Title 46, Series 12, Appendix A)		2	7	5	5	5	5	5	100	700

N/A: There is no established West Virginia groundwater protection standard per Title 46, Series 12 Appendix A
NA: Compound was not analyzed during the sampling event
Note: Only the detected compounds for the analysis have been reported
Note: Shaded areas indicate concentrations which exceed the West Virginia groundwater protection standard

Table 5

Quality Distribution Facility- Institute, WV
Monitoring Well Groundwater Analytical Data
Permit Number: WVR000001719

Unless otherwise noted, all units are in micrograms per liter (ug/l)

Location	Sample Date	Semi Volatile Organic Compounds by EPA Method 8270		
		1,4-Dichlorobenzene	1,2-Dichlorobenzene	Bis(2-ethylhexyl)phthalate
MW-101	8/5/1999	ND (<10)	ND (<10)	ND (<10)
	10/19/1999	ND (<10)	ND (<10)	ND (<10)
	12/27/1999	ND (<10)	ND (<10)	ND (<10)
	3/28/00	ND (<10)	ND (<10)	ND (<5)
	6/28/00	ND(<10)	ND(<10)	ND(<10)
	9/26/00	ND (<10)	ND (<10)	ND (<10)
	12/21/2000	ND (<10)	ND (<10)	ND (<10)
	6/25/2001	ND (<10)	ND (<10)	ND (<10)
	12/13/2001	ND (<10)	ND (<10)	ND (<10)
MW-102	8/5/1999	ND (<10)	ND (<10)	18
	10/19/1999	ND (<10)	ND (<10)	ND (<10)
	12/27/1999	ND (<10)	ND (<10)	ND (<10)
	3/28/00	ND (<10)	ND (<10)	ND (<5)
	6/28/00	ND(<10)	ND(<10)	ND(<10)
	9/26/00	ND (<10)	ND (<10)	ND (<10)
	12/21/2000	ND (<10)	ND (<10)	ND (<10)
	6/25/2001	ND (<10)	ND (<10)	ND (<10)
	12/13/2001	ND (<10)	ND (<10)	ND (<10)
MW-103	8/5/1999	ND (<10)	ND (<10)	ND (<10)
	10/19/1999	ND (<10)	ND (<10)	ND (<10)
	12/27/1999	ND (<10)	ND (<10)	ND (<10)
	3/28/00	ND (<10)	ND (<10)	ND (<5)
	6/28/00	ND(<10)	ND(<10)	ND(<10)
	9/26/00	ND (<10)	ND (<10)	ND (<10)
	12/21/2000	ND (<10)	ND (<10)	ND (<10)
	6/25/2001	ND (<10)	ND (<10)	ND (<10)
	12/13/2001	ND (<10)	ND (<10)	ND (<10)
MW-104	8/5/1999	28	120	19
	10/19/1999	74	510	ND (<10)
	12/27/1999	88	370	ND (<10)
	3/28/00	81	280	ND (<5)
	6/28/00	34	140	ND(<10)
	9/26/00	83	370	ND(<10)
	12/21/2000	65	280	ND(<10)
	6/25/2001	68	290	ND (<10)
	12/13/2001	61	210	ND (<10)
[1] MW-105	8/5/1999	ND (<10)	ND (<10)	ND (<10)
	10/19/1999	ND (<10)	ND (<10)	ND (<10)
	12/27/1999	ND (<10)	ND (<10)	ND (<10)
	3/28/00	ND (<10)	ND (<10)	ND (<5)
	6/28/00	ND(<10)	ND(<10)	ND(<10)
	9/26/00	ND (<10)	10	ND (<10)
	12/21/2000	ND(<10)	ND(<10)	ND(<10)
	6/25/2001	ND(<10)	ND(<10)	ND(<10)
	12/13/2001	ND (<10)	ND (<10)	ND (<10)
MW-106	8/5/1999	ND (<10)	ND (<10)	ND (<10)
	10/16/1999	ND (<10)	ND (<10)	ND (<10)
	12/27/1999	ND (<10)	ND (<10)	ND (<10)
	3/28/00	ND (<10)	11	ND (<5)
	6/28/00	ND(<10)	ND(<10)	ND(<10)
	9/26/00	ND (<10)	ND (<10)	ND (<10)
	12/21/2000	ND (<10)	13	ND (<10)
	6/25/2001	ND(<10)	17	ND(<10)
	12/13/2001	ND (<10)	ND (<10)	ND (<10)
MW-107	9/26/2000	ND (<10)	ND (<10)	ND (<10)
	12/21/2000	ND (<10)	ND (<10)	ND (<10)
	6/25/2001	ND (<10)	ND (<10)	ND (<10)
	12/13/2001	ND (<10)	ND (<10)	ND (<10)
MW-108	9/26/2000	ND (<10)	ND (<10)	ND (<10)
	12/21/2000	ND (<10)	ND (<10)	ND (<10)
	6/25/2001	ND (<10)	14	ND (<10)
	12/13/2001	ND (<10)	ND (<10)	ND (<10)
MW-109	9/26/2000	ND (<10)	ND (<10)	ND (<10)
	12/21/2000	ND (<10)	ND (<10)	ND (<10)
	6/25/2001	ND (<10)	18	ND (<10)
	12/13/2001	ND (<10)	ND (<10)	ND (<10)
MW-110	9/26/2000	ND (<10)	ND (<10)	ND (<10)
	12/21/2000	ND (<10)	ND (<10)	ND (<10)
	6/26/2001	ND (<10)	ND (<10)	ND (<10)
	12/13/2001	ND (<10)	ND (<10)	ND (<10)
West Virginia Groundwater Protection Standard (Title 46, Series 12, Appendix A)		75	600	6

Note: Only the detected compounds for the analysis have been reported
Note: Shaded areas indicate concentrations which exceed the West Virginia groundwater protection standard
N/A: No standard was given in Appendix A for the specific compound
NA: Compound was not analyzed during the sampling event

HYDRAULIC CONDUCTIVITY TESTING

In August 2000, SAIC completed hydrologic testing on all ten on-site monitoring wells (MW-101 through MW-110) using both rising and falling head test (slug test) methods. The tests were completed to evaluate the hydraulic conductivity of the saturated unconsolidated material intercepted by each well. The term hydraulic conductivity is defined as "the capacity of a porous medium to transmit water under a unit gradient" or the time rate of groundwater discharge of the aquifer under unit conditions. The testing consisted of the instantaneous removal of a predetermined volume of water (slug) from the well, followed by the continuous measurement of the rate of recharge as the water level recovered to pre-slug removal conditions. The recovery data for each test was evaluated using the Bouwer and Rice Method (1988).

Table 6 provides a summary of the results of the hydraulic conductivity testing at each monitoring well. Results of the testing indicated that the average hydraulic conductivity values range from 0.39 gpd/ft^2 in MW-103 to 430.3 gpd/ft^2 in MW-108. Graphic results of the slug test are shown in Appendix D. Conductivity values were less than 10 gpd/ft^2 at all of the monitoring wells with the exception of MW-101, MW-107, MW-108, and MW-109. These results suggest that the overburden exhibits moderate to low hydraulic conductivity values typical of the soils encountered during drilling at the site.

An evaluation of the velocity of groundwater migration beneath the site was performed using the results of the hydraulic conductivity testing, an average porosity of 32.4 percent, and the groundwater elevation data from the December 21, 2001 sampling, which is consistent with all of the previous sampling events. The result of the groundwater velocity calculation is included with the graphic results in Appendix D and demonstrates that groundwater is moving toward the south at an average rate of 128 feet per day or 46,883 feet per year (ft/yr). This calculated groundwater velocity rate is very high and can be attributed to the steep groundwater gradient, and the site being location at the base of a steep topographical slope. The groundwater velocity is expected to decrease with distance from the site as the gradient decreases in the floodplain of the Kanawha River.

Table 6

Quality Distribution Facility- Institute, WV
Hydraulic Conductivity Results
Permit Number: WVR000001719

Location	Falling Head Test (gallons per day per square foot)	Rising Head Test (gallons per day per square foot)	Average Hydraulic Conductivity (gallons per day per square foot)
MW-101	75.16	83.47	79.32
MW-102	1.11	0.76	0.94
MW-103	0.46	0.33	0.39
MW-104	7.26	5.07	6.17
MW-105	3.33	3.88	3.61
MW-106	8.54	5.82	7.18
MW-107	32.75	54.07	43.41
MW-108	432.80	427.80	430.30
MW-109	95.44	123.00	109.22
MW-110	1.64	9.65	5.64
Site Average			68.62

RECEPTOR EVALUATION

SAIC evaluated the potential risk that the impacted site groundwater poses to both on-site and off-site receptors. In identifying risk, potential receptors were identified and an exposure pathway flowchart was completed for each impacted media (Figure 6 and Table 7). Since the previous characterization activities demonstrated that there are no impacted surface soils, impacted subsurface soils, or free phase liquid plume present at the site, these pathways were eliminated. Using the data collected during all previous on-site characterization activities, the following potential exposure pathways were identified based on thc presence of the dissolved groundwater plume beneath the site:

- The outdoor inhalation of volatile vapors for both commercial and construction workers.
- The migration of impacted groundwater to a potable water source.
- The migration of impacted groundwater to a surface water body.

Outdoor Inhalation of Volatile Vapors

To determine the concentration within the subsurface groundwater required to create an exposure risk of inhaling volatile vapors outdoors, the computer model "RBCA Tool Kit" was utilized. The RBCA Tool Kit utilizes site-specific data to calculate site-specific target levels (SSTL's) using standardized EPA recognized empirical formulas for a selected exposure route. The input data utilized in the model along with the output table is included as Appendix E. Table 8 summarizes the results of the model and the comparison to maximum detected concentrations on-site. The model results demonstrate that none of the maximum detected concentrations on-site have exceeded the SSTL's for outdoor volatile air exposure. Therefore, as the concentrations of compounds dissolved in groundwater are expected to remain stable or decline, there is no risk of exposure by the inhalation of volatile vapors outdoors.

Groundwater Migration to a Potable Water Source

The potential for the dissolved groundwater plume present beneath the site migrating to a potable water supply well was evaluated. Both the DEP and the State Health Department were contacted to determine the location of potable water supply wells in the vicinity of the site. The DEP only inventories the location of groundwater monitoring wells. The St. Albans District office of the Health Department does keep an inventory of water supply wells in the vicinity of the site. The staff engineer stated that there are no supply wells within 2,500 feet of the site.

Figure 6
Chemical Leaman Tank Lines; Institute, WV
Exposure Pathway Flowchart

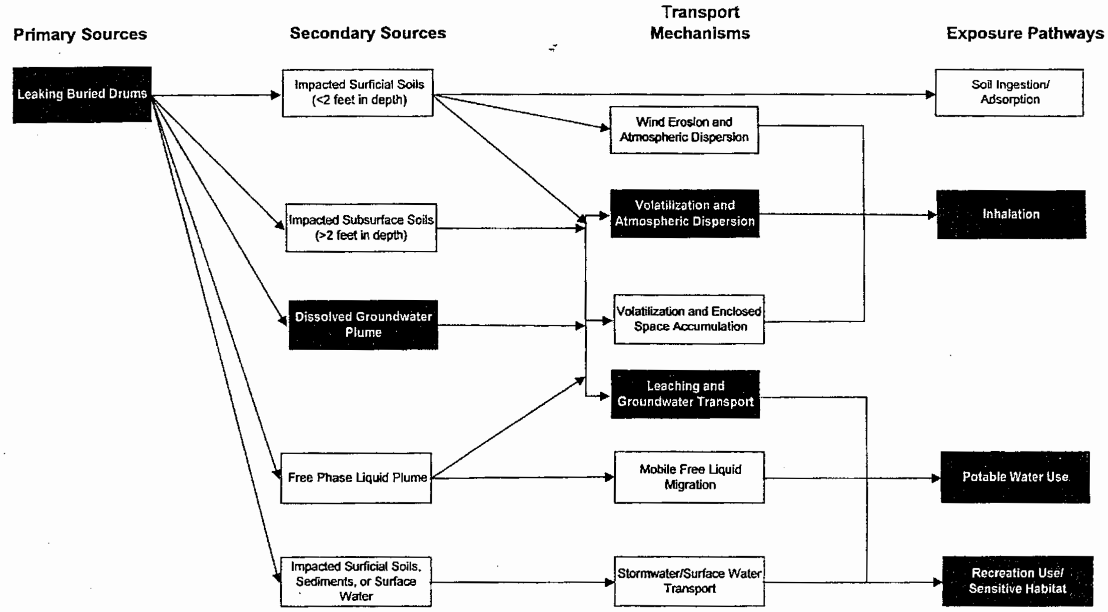


Table 7
Quality Distribution Facility- Institute, WV
Exposure Pathway Evaluation
Permit Number: WVR000001719

Contaminated Media	Exposure Route	Receptor Characterization	Potential Exposure Pathway (Yes/No)	Rationale for Inclusion or Exclusion
Surface Soil (< 2 feet in depth)	Incidental Ingestion / Dermal Contact	Residential	No	There are no impacted surface soils a the site
		Commercial/Industrial	No	There are no impacted surface soils a the site
		Construction	No	There are no impacted surface soils a the site
		Sensitive Habitat	No	There are no impacted surface soils a the site
	Inhalation of Dust	Residential	No	There are no impacted surface soils a the site
		Commercial/Industrial	No	There are no impacted surface soils a the site
		Construction	No	There are no impacted surface soils a the site
		Sensitive Habitat	No	There are no impacted surface soils a the site
	Inhalation of Volatiles (Indoors)	Residential	No	There are no impacted surface soils a the site
		Commercial/Industrial	No	There are no impacted surface soils a the site
		Construction	No	There are no impacted surface soils a the site
		Sensitive Habitat	No	There are no impacted surface soils a the site
	Inhalation of Volatiles (Outdoors)	Residential	No	There are no impacted surface soils a the site
		Commercial/Industrial	No	There are no impacted surface soils a the site
		Construction	No	There are no impacted surface soils a the site
		Sensitive Habitat	No	There are no impacted surface soils a the site
Subsurface Soil (> 2 feet in depth)	Incidental Ingestion / Dermal Contact	Residential	No	There are no impacted subsurface soils a the site
		Commercial/Industrial	No	There are no impacted subsurface soils a the site
		Construction	No	There are no impacted subsurface soils a the site
		Sensitive Habitat	No	There are no impacted subsurface soils a the site
	Inhalation of Volatiles (Indoors)	Residential	No	There are no impacted subsurface soils a the site
		Commercial/Industrial	No	There are no impacted subsurface soils a the site
		Construction	No	There are no impacted subsurface soils a the site
		Sensitive Habitat	No	There are no impacted subsurface soils a the site
	Inhalation of Volatiles (Outdoors)	Residential	No	There are no impacted subsurface soils a the site
		Commercial/Industrial	No	There are no impacted subsurface soils a the site
		Construction	No	There are no impacted subsurface soils a the site
		Sensitive Habitat	No	There are no impacted subsurface soils a the site
	Leaching to Potable Groundwater	Residential	No	There are no impacted subsurface soils a the site
		Commercial/Industrial	No	There are no impacted subsurface soils a the site
		Construction	No	There are no impacted subsurface soils a the site
		Sensitive Habitat	No	There are no impacted subsurface soils a the site
Dissolved Groundwater Plume	Inhalation of Volatiles (Indoors)	Residential	No	There are no buildings present over the groundwater plume
		Commercial/Industrial	No	There are no buildings present over the groundwater plume
		Construction	No	There are no buildings present over the groundwater plume
		Sensitive Habitat	No	There are no buildings present over the groundwater plume
	Inhalation of Volatiles (Outdoors)	Residential	No	There are no residential dwellings present over the groundwater plume
		Commercial/Industrial	Yes	Groundwater may volatilize into the outdoor air
		Construction	Yes	Groundwater may volatilize into the outdoor air
		Sensitive Habitat	No	There are no sensitive habitats in the area
	Leaching to Potable Groundwater	Residential	No	There are no potable wells within 2,500 feet of the site
		Commercial/Industrial	No	There are no potable wells within 2,500 feet of the site
		Construction	No	There are no potable wells within 2,500 feet of the site
		Sensitive Habitat	No	There are no potable wells within 2,500 feet of the site
Free Phase Liquid Plume	Free Phase Liquid Plume	Residential	No	There is no free-phase liquid present in the subsurface
		Commercial/Industrial	No	There is no free-phase liquid present in the subsurface
		Construction	No	There is no free-phase liquid present in the subsurface
		Sensitive Habitat	No	There is no free-phase liquid present in the subsurface
Surface Water / Sediments	Incidental Ingestion / Dermal Contact	Recreational Users	Yes	Groundwater may migrate to the Kanawha River
		Sensitive Habitat	No	There are no sensitive habitats in the area

Note: Exposure routes which are potental exposure pathways are shaded

Table 8

Quality Distribution Facility- Institute, WV
Groundwater to Outdoor Air Pathway Risk Evaluation
Permit Number: WVR000001719

Compound	Maximum Concentration Detected on site (ug/l)	Monitoring Well and Date Where Maximum Concentration Was Detected	Modeled Maximum Concentration which will Potentially Cause an Exposure Risk [SSTL] (ug/l)	Modeled Maximum Concentration Exceeded (Yes/No)
Benzene	160	MW-104 on 09/05/99	20,000	No
Chlorobenzene	31,000	MW-104 on 09/26/00	200,000	No
1,4-Dichlorobenzene	93	MW-104 on 09/26/00	> 145,000	No
1,2-Dichloroethane	56	MW-106 on 06/29/00	24,000	No
bis (2-ethylhexyl) phthalate	19	MW-104 on 09/05/99	>343	No
Tetrachloroethene	310	MW-106 on 10/18/99	70,000	No
1,1,2-Trichloroethane	93	MW-106 on 9/26/00	77,000	No
Trichloroethene	400	MW-106 on 9/26/00	52,000	No
Vinyl Chloride	40	MW-106 on 09/05/99	110	No

Note: Risk Concentrations were calculated using the RBCA Tool-kit computer model
SSTL: Site Specific Target Level

The engineer also stated that all of the properties in the vicinity of the site are supplied by public water from the West Virginia American Water Company (WVAWC). WVAWC uses treated water from the Elk River, located in South Charleston, as their water supply.

Since all of the properties within 2,500 feet of the site are supplied with potable water by WVAWC, there is no potential that the dissolved groundwater plume present beneath the site will impact potable water wells.

To protect future on-site groundwater use, a deed restriction for the facility will be completed. The restriction will prohibit the installation and use of a potable water well in the vicinity of the existing groundwater plume.

Groundwater Migration to a Surface Water Body

The closest downgradient surface water body to the site is the Kanawha River located 1,200 feet south of the site. In evaluating this exposure route, a computer model entitled FATBACK (fate and transport backwards) was utilized. FATBACK uses the "Domenico equation" to calculate a source concentration given a specific receptor concentration and the location at the receptor. A general description of the FATBACK model is included in Appendix F.

FATBACK was utilized to calculate the required concentration of each COC at the facility's compliance point (downgradient property boundary) if the groundwater concentration at the river was equal to the West Virginia groundwater protection standard. The results of the modeling are included in Appendix G and summarized in Table 9. Results demonstrate that the concentrations of all COC's required to impact the Kanawha River are at least ten (10) times the maximum detected concentration detected on-site. Since there is no free phase product on-site, and maximum concentrations of the COC's detected on-site are more than ten (10) times less than the modeled concentrations required to impact the Kanawha River, there is no risk to the Kanawha River from the dissolved compounds present beneath the site.

Table 9

Quality Distribution Facility- Institute, WV
Kanawha River Risk Exposure Summary Table
Permit Number: WVR000001719

All units are in micrograms per liter (ug/l)

Compound	Maximum Concentration Detected On-Site	Modeled On-Site Concentration Required to Impact the Kanawha River
Benzene	160	27,300,000
Chlorobenzene	31,000	1,000,000,000
1,4-Dichlorobenzene	93	1,000,000,000
1,2-Dichloroethane	56	6,750
bis (2-ethylhexyl) phthalate	19	1,000,000,000
Tetrachloroethene	310	134,000
1,1,2-Trichloroethane	93	4,980
Trichloroethene	400	3,880
Vinyl Chloride	40	1,120

CORRECTIVE ACTION GOALS

The goals of the corrective action are to prevent the exeedance of the West Virginia groundwater protection standards for each COC at the downgradient property boundary and to protect the risk of exposure to both on-site and off-site receptors.

CORRECTIVE ACTION EVALUATION

The facility permit states that a corrective action plan meeting the criteria of 40 CFR 264.100 will be prepared if any constituent exceeding the maximum concentration allowed in Permit Condition IV-C-2 has occurred. Since nine compounds have been detected at concentrations exceeding the limits set in Permit Condition IV-C-2, a permit modification detailing an applicable corrective action must be made. However, prior to recommending a suitable corrective action, several corrective action options were evaluated. The estimated costs to complete each option are summarized in Table 10. Five (5) potential corrective action options were evaluated for this facility and are listed below:

- Groundwater pumping and on-site treatment
- Groundwater sparging coupled with soil vacuum extraction
- Chemical oxidation
- In-situ biodegradation
- Monitored natural attenuation

In evaluating each corrective action option; applicability, effectiveness, and cost were evaluated. The estimated time to completion and costs were developed based on the nature of the characterized subsurface materials and SAIC's experience in completing similar projects.

Groundwater Pumping and On-Site Treatment

Groundwater pumping and on-site treatment could eventually remediate the groundwater on-site and treat the discharge to levels below the West Virginia Groundwater Protection Standards. Approximately twelve (12) groundwater recovery wells would be installed to remove impacted groundwater and to prevent any potential migration. The groundwater extracted from the recovery wells could be pumped into the existing on-site treatment system, depending on volume and contaminant concentrations, and treated prior to discharge under a revised facility NPDES permit. The effectiveness of the pumping system would be evaluated by completing quarterly groundwater sampling.

Table 10

Quality Distribution Facility- Institute, WV
Corrective Action Pricing Evaluation
Permit Number: WVR000001719

	Quantity	Unit Rate	Total Cost
Groundwater Pumping and On-Site Treatment			
System Installation	1	$350,000	$350,000
O&M with water treatment (Year)	10	$75,000	$750,000
Quarterly Sampling (per event)	48	$12,500	$600,000
Remediation Well Abandonment	1	$25,000	$25,000
Total Option Cost			$1,725,000
Groundwater Air Sparging with Soil Vacuum Extraction			
System Installation	1	$140,000	$140,000
O&M with Carbon Regeneration (Year)	5	$60,000	$300,000
Quarterly Sampling (per event)	28	$12,500	$350,000
Remediation Well Abandonment	1	$25,000	$25,000
Total Option Cost			$815,000
Chemical Oxidation			
Injection Well Installation and Permitting	1	$120,000	$120,000
Chemical Purchase and Injection (per event)	3	$65,000	$195,000
Quarterly Sampling (per event)	16	$12,500	$200,000
Injection Well Abandonment	1	$20,000	$20,000
Total Option Cost			$535,000
In-Situ Biodegradation			
Bio-Amendment Application	1	$35,000	$35,000
Semi-Annual Sampling (per event)	10	$12,500	$125,000
Total Option Cost			$160,000
Monitored Natural Attenuation			
Semi-Annual Sampling (per event)	10	$12,500	$125,000
Total Option Cost			$125,000

Advantages: Pumping should reduce contamination levels in groundwater and control any potential contaminated groundwater migration.

Disadvantages: Active remediation is not required to obtain the corrective action goals. VOC contaminant removal as a dissolved phase is inefficient due to the slow dissolution into groundwater and the high adsorption by soils and rock materials. A large volume of water will be removed from the aquifer, treated, and discharged to the Kanawha River over a potentially long time. With pipes containing water, there is the potential for both mechanical and freezing problems. The installation and operation of a groundwater pumping system could impact the site operations.

Estimated Cost: $ 1,725,000

Estimated Time to Completion: 12 years

Groundwater Air Sparging with Soil Vacuum Extraction

Air sparging (AS) and soil vacuum extraction (SVE) could treat the groundwater on-site to levels below the West Virginia Groundwater Protection Standards. Approximately fifteen (15) air sparging (AS) wells and fifteen (15) soil vacuum extraction (SVE) wells would be necessary to volatilize and recover the compounds dissolved in the groundwater. The AS wells would be utilized to inject compressed air below the groundwater table to volatilize the dissolved compounds. Although the soils have already been remediated by excavation, SVE may be necessary to capture and collect the vapors released by the sparging of the groundwater. The collected vapors would be treated using activated carbon prior to atmospheric discharge. Additionally, AS promotes natural biodegradation of hydrocarbons by increasing the dissolved oxygen (DO) concentration in the groundwater. The effectiveness of the system in removing VOC's and SVOC's would be monitored by completing quarterly groundwater sampling.

Advantages: No removal of groundwater is required for AS/SVE. Reduced operation time can be expected when compared to groundwater extraction and above ground treatment.

Disadvantages: Active remediation is not required to obtain the corrective action goals. Although AS/SVE can likely address the VOC's in less time than groundwater pumping it is not as timely as oxidation. SVOC's are typically not effectively treated using AS/SVE through aeration. AS/SVE would have mechanical equipment requiring maintenance. The process would also produce

Estimated Cost: $ 535,000

Estimated Time to Completion: 4 years

In-Situ Biodegradation

In-situ biodegradation utilizes bio-amendments to accelerate the activity of the naturally occurring microorganisms. The bio-amendments are injected as liquid slurry into the saturated zone through either existing monitoring wells or injection points. The effects of the bio-amendments in accelerating the reduction of COC concentrations will be monitored by the continued sampling of all of the on-site monitoring wells semi-annually. The sampling will continue until COC concentrations meet regulatory requirements at the point of compliance.

Advantages: No residual waste is generated. No handling of hazardous substances. No impact to site operations. No Active Remediation. Time to completion should be quicker than monitored natural attenuation.

Disadvantages: Dependant on the activity of naturally occurring microorganisms in reducing COC concentrations.

Estimated Cost: $ 160,000

Estimated Time to Completion: 5 years

Monitored Natural Attenuation

Monitored natural attenuation (MNA) consists of continued sampling of all of the monitoring wells semi-annually. The sampling would continue until COC concentrations meet regulatory requirements at the point of compliance.

Advantages: No active remediation is required. No residual waste is generated. No handling of hazardous substances. No impact to site operations.

Disadvantages: No active remediation is being conducted. Therefore, the time to reduce COC's to regulatory levels is unknown.

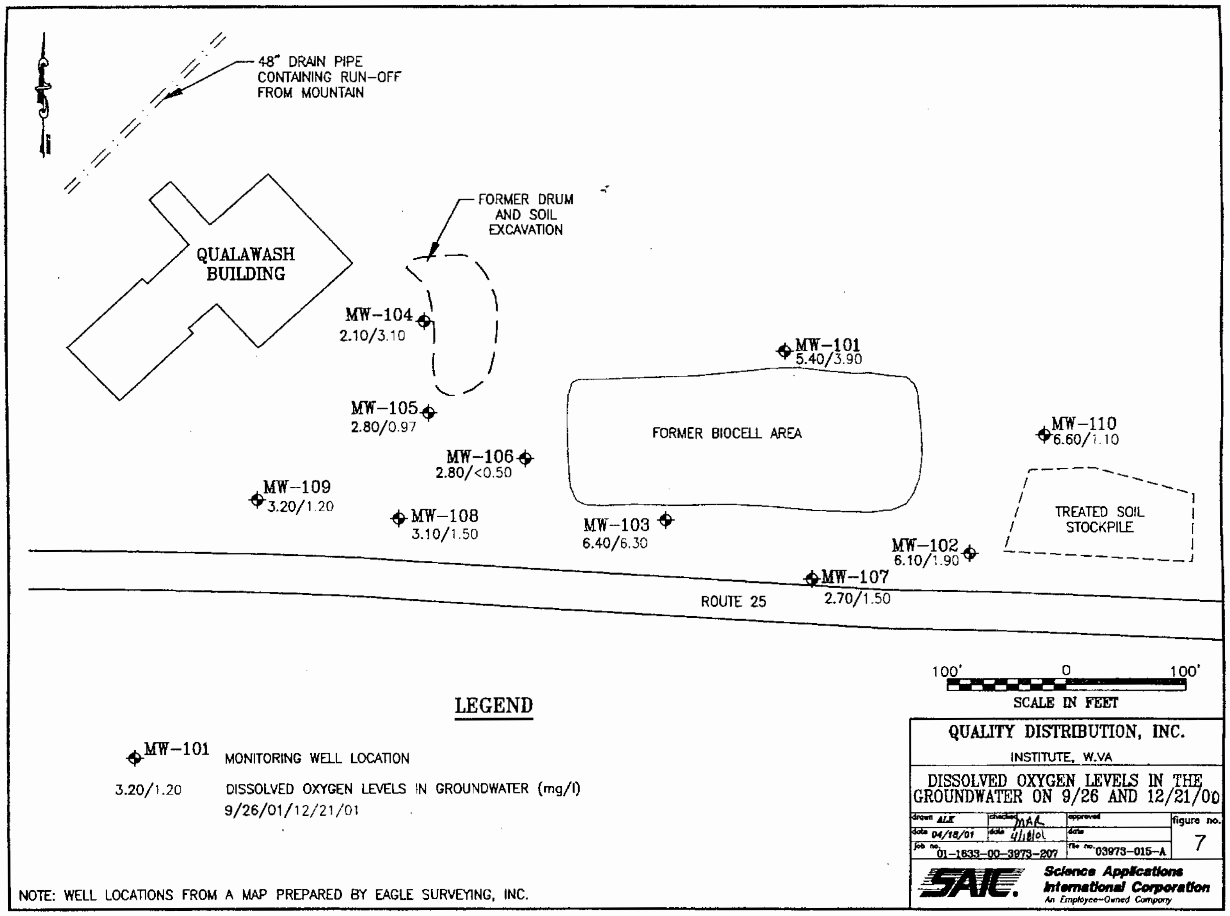
Estimated Cost: $ 125,000

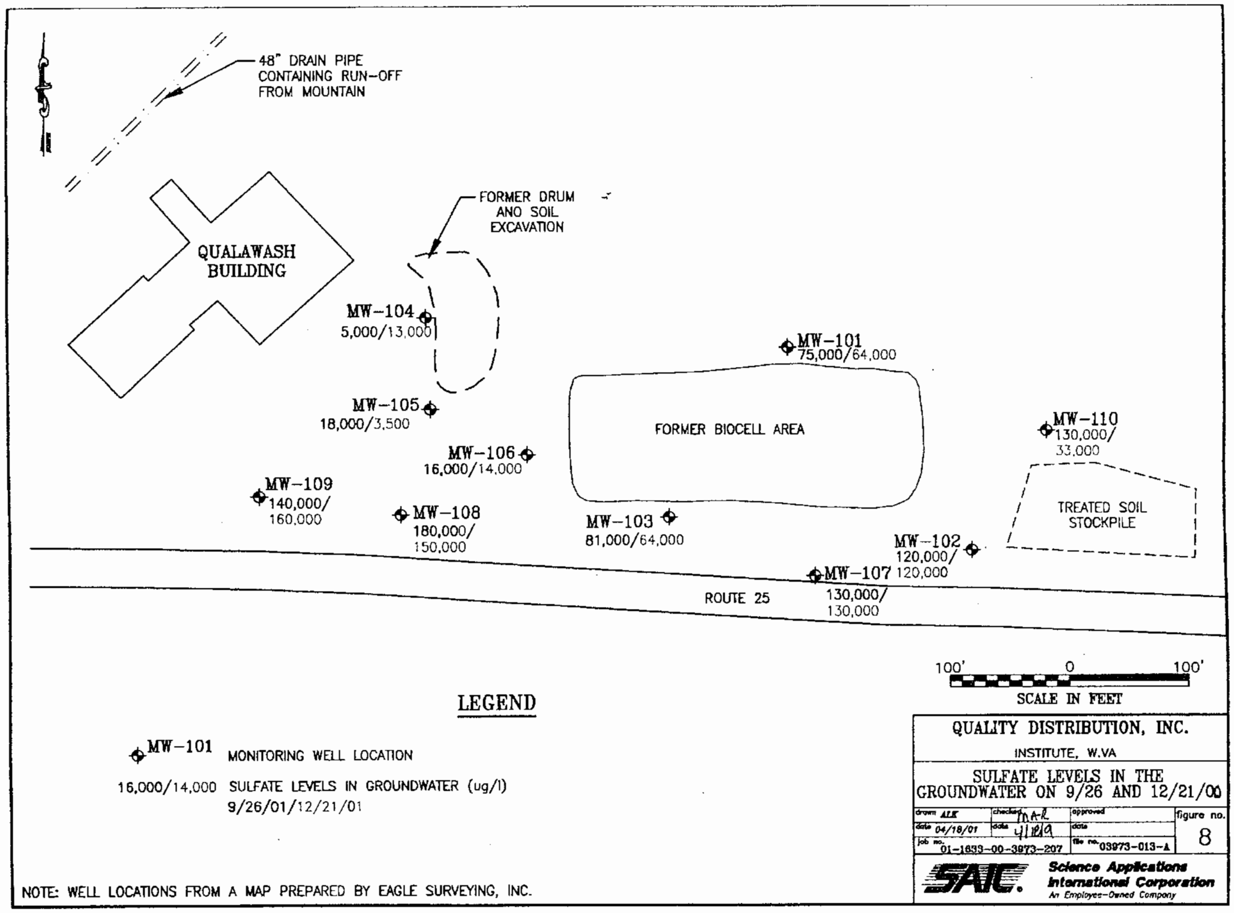
Estimated Time to Completion: 5 plus years

SELECTED CORRECTIVE ACTION

Based on the data collected during all of the characterization investigations and the evaluation of all of the applicable corrective action options, in-situ biodegradation is the corrective action recommended for this site. This corrective action will comply with the responsibilities outlined within 40 CFR 264.100 and was recommended for the following reasons:

- The lack of both on-site and off-site receptors reduces the need for aggressive remediation.
- All source material has been removed, resulting in generally stable or declining COC concentrations within the on-site plume.
- Absence of free phase product.
- Cost effectiveness of in-situ biodegradation results from minimal capital cost.
- Natural attenuation is currently occurring within the plume on-site as demonstrated by the depleted dissolved oxygen and sulfate concentrations in the vicinity of the former source area (Figures 7 and 8). The addition of ORC and nitrogen to the subsurface will enhance the natural attenuation process that is already occurring.
- The West Virginia groundwater protection standards are currently being met at the downgradient property boundary (compliance point).
- No hazardous substances are used in the remediation process.


48" DRAIN PIPE
CONTAINING RUN-OFF
FROM MOUNTAIN
FORMER DRUM
AND SOIL
EXCAVATION
QUALAWASH
BUILDING
MW-104
2.10/3.10
MW-101
5.40/3.90
MW-105
2.80/0.97
FORMER BIOCELL AREA
MW-110
6.60/1.10
MW-106
2.80/<0.50
MW-109
3.20/1.20
MW-108
3.10/1.50
MW-103
6.40/6.30
TREATED SOIL
STOCKPILE
MW-102
6.10/1.90
MW-107
2.70/1.50
ROUTE 25
100'
0
100'
SCALE IN FEET
LEGEND
MW-101
MONITORING WELL LOCATION
3.20/1.20
DISSOLVED OXYGEN LEVELS IN GROUNDWATER (mg/l)
9/26/01/12/21/01
QUALITY DISTRIBUTION, INC.
INSTITUTE, W.VA
DISSOLVED OXYGEN LEVELS IN THE
GROUNDWATER ON 9/26 AND 12/21/00
drawn ALK
checked MAK
approved
figure no.
date 04/18/01
date 4/18/01
date
7
job no. 01-1833-00-3973-207
file no. 03973-015-A
SAIC.
Science Applications
International Corporation
An Employee-Owned Company
NOTE: WELL LOCATIONS FROM A MAP PREPARED BY EAGLE SURVEYING, INC.


48" DRAIN PIPE CONTAINING RUN-OFF FROM MOUNTAIN
QUALAWASH BUILDING
FORMER DRUM AND SOIL EXCAVATION
MW-104 5,000/13,000
MW-101 75,000/64,000
MW-105 18,000/3,500
FORMER BIOCELL AREA
MW-110 130,000/ 33,000
MW-106 16,000/14,000
MW-109 140,000/ 160,000
MW-108 180,000/ 150,000
MW-103 81,000/64,000
TREATED SOIL STOCKPILE
MW-102 120,000/ 120,000
MW-107 130,000/ 130,000
ROUTE 25
100' 0 100'
SCALE IN FEET
LEGEND
MW-101 MONITORING WELL LOCATION
16,000/14,000 SULFATE LEVELS IN GROUNDWATER (ug/l) 9/26/01/12/21/01
QUALITY DISTRIBUTION, INC.
INSTITUTE, W.VA
SULFATE LEVELS IN THE GROUNDWATER ON 9/26 AND 12/21/00
drawn ALK
checked MAR
approved
figure no. 8
date 04/18/01
job no. 01-1633-00-3973-207
file no. 03973-013-A
SAIC. Science Applications International Corporation
An Employee-Owned Company
NOTE: WELL LOCATIONS FROM A MAP PREPARED BY EAGLE SURVEYING, INC.

CORRECTIVE ACTION WORKPLAN

Bio-Amendment Introduction Workplan

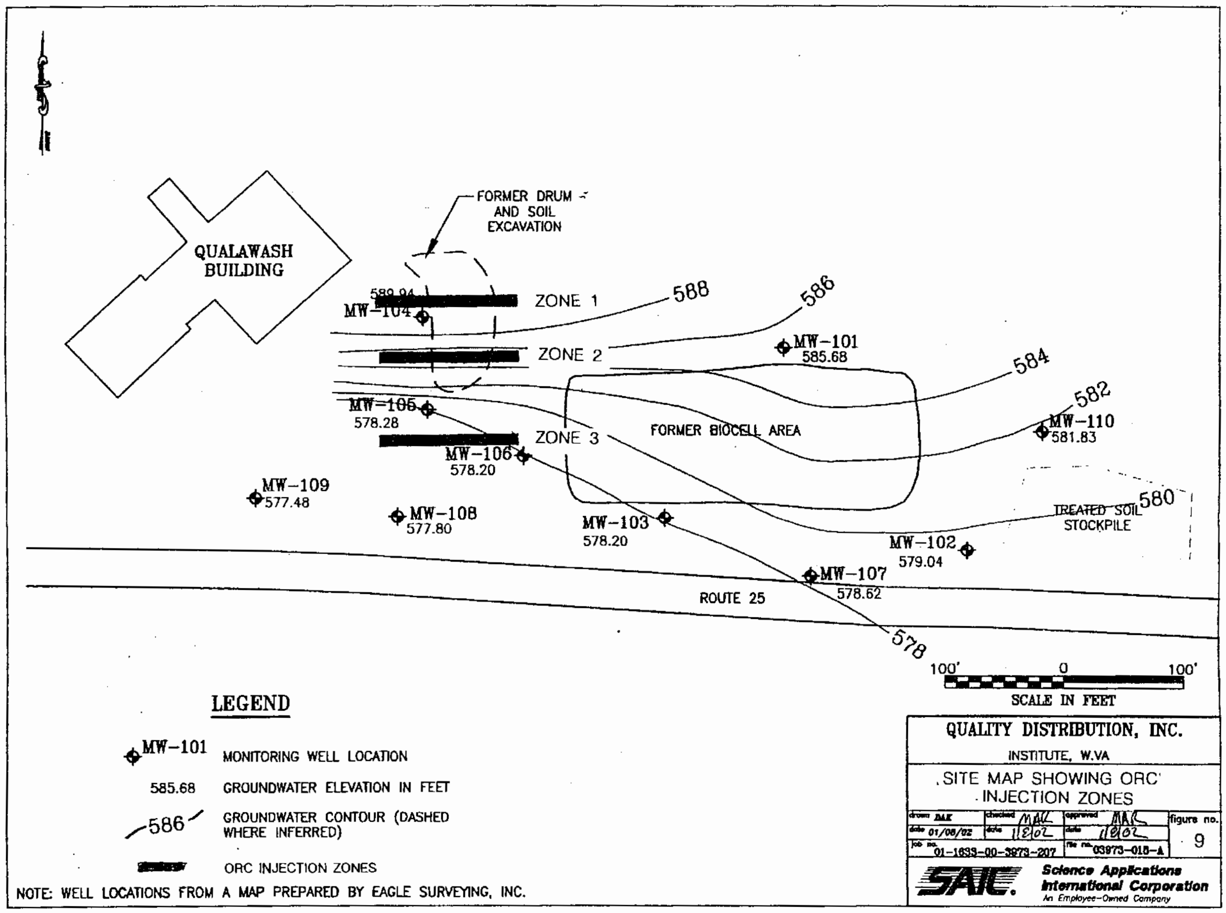
A Geoprobe will be used to install a total of 36 soil borings along three zones within and around the former drum and soil excavation (Figure 9). The ORC and ammonium sulfate will be injected into the subsurface through the Geoprobe rods fitted with a high pressure grout pump. In addition to the ORC borings, an ammonium sulfate solution will be injected into existing monitoring wells MW-104, MW-105, MW-106, MW-108, and MW-109.

Prior to completing any subsurface injection, a permit will be obtained from the West Virginia DEP. This permit will detail the volume of injected material, the chemical composition of the injected material, the need for injection, and the anticipated injection dates.

ORC Injection

Pure ORC powder will be mixed with site potable water and ammonium sulfate to produce a nitrogen enriched ORC slurry. A Geoprobe will be used to install 36 1-inch diameter holes in and around the former drum and soil excavation through which a total of 1,350 pounds of ORC will be injected into the saturated zone. Due to the clayey texture of the soils, additional injection points may be necessary to apply the required volume of ORC. The methodology that will be used to complete the ORC injection is as follows:

1. Identify the location of all underground structures and utilities.
2. Pre-mark the installation grid point locations, noting any that have special depth requirements.
3. Set up the Geoprobe unit over drilling location.
4. Penetrate surface pavement or concrete using a diamond tipped auger bit.
5. Drive a 1-inch diameter Geoprobe rod probe fitted with an expendable tip to the desired maximum depth. No drilling cuttings will be produced as the rod is driven into the ground.
6. Upon reaching a depth equal to 5 feet below the groundwater table, the drive rods will be disconnected from the expendable tip.
7. Mix approximately 37.5 pounds of ORC with 6.7 gallons of water to create a slurry for injection into the current drive point.



QUALAWASH BUILDING
FORMER DRUM AND SOIL EXCAVATION
ZONE 1
ZONE 2
ZONE 3
588
586
584
582
580
578
MW-104
589.94
MW-101
585.68
MW-105
578.28
MW-106
578.20
MW-109
577.48
MW-108
577.80
MW-103
578.20
MW-110
581.83
MW-102
579.04
MW-107
578.62
FORMER BIOCELL AREA
TREATED SOIL STOCKPILE
ROUTE 25
100' 0 100'
SCALE IN FEET
LEGEND
MW-101 MONITORING WELL LOCATION
585.68 GROUNDWATER ELEVATION IN FEET
586 GROUNDWATER CONTOUR (DASHED WHERE INFERRED)
ORC INJECTION ZONES
NOTE: WELL LOCATIONS FROM A MAP PREPARED BY EAGLE SURVEYING, INC.
QUALITY DISTRIBUTION, INC.
INSTITUTE, W.VA
SITE MAP SHOWING ORC INJECTION ZONES
drawn DAK
checked MAC
approved MAC
date 01/08/02
figure no. 9
job no. 01-1633-00-3973-207
file no. 03973-018-A
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8. Set up the Geoprobe slurry pump and connect the pump to the probe grout pull cap via a 1-inch diameter delivery hose. The hose will then be attached to the 1" drive rod with its quick connector fitting. Upon confirmation that all connections are tight, add the ORC slurry to the pump hopper/tank.
9. While slowly withdrawing the pre-probe and drive stem to the top of the saturated zone, begin to pump the predetermined amount of ORC slurry into the aquifer. While pumping the slurry into the aquifer, observe pump pressure levels for indications of slurry dispersion or refusal into the aquifer. (Increasing pressure will indicate reduced acceptance of material by the aquifer).
10. Upon the completion of the ORC slurry injection, a granular bentonite seal will be installed above the ORC slurry through the entire vadose zone. This helps assure that the slurry stays in place and prevents contaminant migration from the surface.
11. Prior to moving to the next injection point, all of the drive rods will be cleaned with potable water to remove all ORC residue.

Nutrient Injection

To complement the ORC injection, nitrogen in the form of ammonium sulfate, will be dissolved in water and used to mix the ORC slurry. The ammonium sulfate pellets will be mixed with tap water on-site in a 425 gallon polyethylene tank in batches. In addition to the ORC injection points, dissolved nitrogen will be added through existing monitoring wells MW-104, MW-105, MW-106, MW-108, and MW-109. A total of 800 pounds of ammonium sulfate will be applied to the subsurface to increase nitrogen levels within the groundwater to approximately 200 mg/l

In-Situ Biodegradation Workplan

The effectiveness of the in-situ biodegradation will be completed by performing semi-annual sampling at all on-site groundwater monitoring wells (MW-101 through MW-110). The sampling data will be incorporated into the existing database, evaluated, and reported to DEP. The data will be utilized to confirm that groundwater that exceeds the West Virginia groundwater protection standard is not migrating off-site and that on-site receptors are not at risk of being exposed

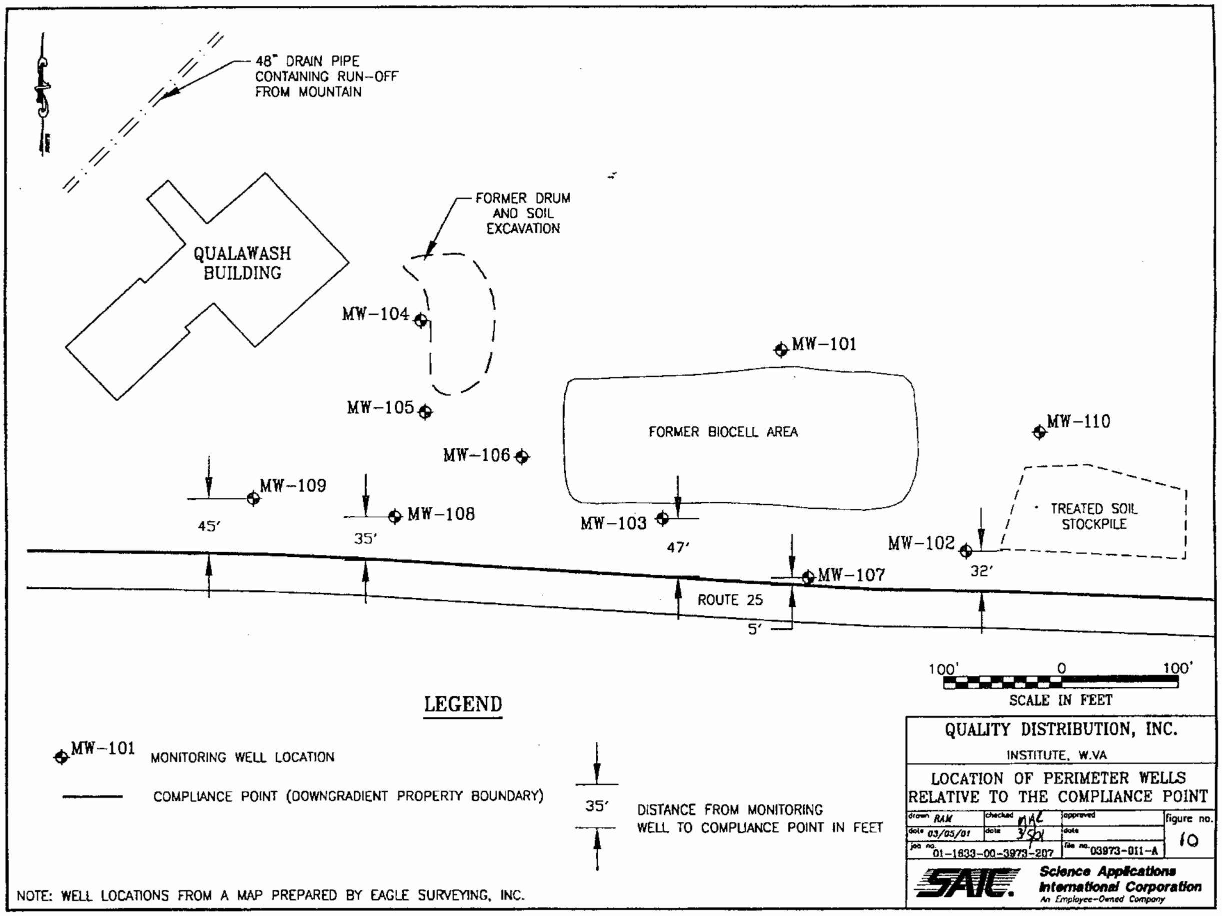
To determine that groundwater migrating off-site meets the West Virginia groundwater protection standard during in-situ biodegradation corrective action, modeled groundwater SSTL's for each perimeter monitoring well (MW-102, MW-103, MW-107, MW-108, and MW-109) were calculated using FATBACK. In completing the modeling, the groundwater concentration for each COC at the compliance point (downgradient property boundary) was set to equal the West Virginia groundwater protection standard. FATBACK then calculated the SSTL at each perimeter monitoring well which would result in a concentration at the compliance point equal to the standard (Figure 10). Table 11 summarizes the modeled perimeter well SSTL's with the FATBACK model sheets included as Appendix H.

In addition to the perimeter wells, the data collcted from the remaining on-site wells will be compared to the SSTL's determined in the evaluation of the groundwater to outdoor air pathway risk evaluation. This will ensure that there is no exeedance of the groundwater protection standard at and beyond the compliance point and that no on-site receptors are at risk.

Groundwater Sampling Methods

In completing the semi-annual sampling, the following methods will be used. Prior to commencement of groundwater sampling, the groundwater surface in the monitoring wells MW-101 through MW-110 will be gauged for the presence of non-aqueous phase liquids (NAPL), depth to static water level (SWL), and total well depth. Assuming no NAPL is detected and using the SWL measurements, the volume of water in the monitoring well will be calculated, and a volume of water equal to at least three times the standing well volume will be purged from the well using either a decontaminated submersible pump or dedicated hand bailer. All equipment entering the well must either be new and dedicated to the well or decontaminated using a steam cleaner with detergent and deionized water rinse. All purge and decontamination water generated will be contained in 55-gallon drums and transported to the facility's drum storage pad prior to disposal at the facility wastewater treatment plant.

Groundwater sampling will be conducted after the purging and only after the groundwater levels have recovered to within 75 percent of the pre-purged groundwater levels. No sample will be collected if the presence of NAPLs is determined. Groundwater samples will be collected using a dedicated weighted plastic polyethylene bailer with a ball check valve. The bailer will be lowered, filled, raised, and emptied to waste three times before commencement of any sample collection. One water sample will be collected from each monitoring



48" DRAIN PIPE CONTAINING RUN-OFF FROM MOUNTAIN
QUALAWASH BUILDING
FORMER DRUM AND SOIL EXCAVATION
MW-104
MW-105
MW-106
MW-101
FORMER BIOCELL AREA
MW-110
TREATED SOIL STOCKPILE
MW-109
45'
MW-108
35'
MW-103
47'
MW-102
32'
MW-107
ROUTE 25
5'
100' 0 100'
SCALE IN FEET
LEGEND
MW-101 MONITORING WELL LOCATION
COMPLIANCE POINT (DOWNGRADIENT PROPERTY BOUNDARY)
35' DISTANCE FROM MONITORING WELL TO COMPLIANCE POINT IN FEET
NOTE: WELL LOCATIONS FROM A MAP PREPARED BY EAGLE SURVEYING, INC.
QUALITY DISTRIBUTION, INC.
INSTITUTE, W.VA
LOCATION OF PERIMETER WELLS RELATIVE TO THE COMPLIANCE POINT
drawn RAM
date 03/05/01
job no. 01-1633-00-3973-207
file no. 03973-011-A
figure no. 10
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Table 11

Quality Distribution Facility- Institute, WV
Groundwater Perimeter Well Evaluation & SSTL Summary
Permit Number: WVR000001719

All units are in micrograms per liter (ug/l)

Monitoring Well		Benzene	Chlorobenzene	1,4-Dichlorobenzene	1,2-Dichloroethane	bis (2-ethylhexyl) phthalate	Tetrachloroethene	1,1,2-Trichloroethane	Trichloroethene	Vinyl Chloride
MW-109	Maximum Detected Concentration	ND (<5)	210	ND (<10)	ND (<5)	ND (<10)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	SSTL	299	22,600	45,300	219	1,000,000,000	245	216	214	84.7
MW-108	Maximum Detected Concentration	ND (<5)	82	ND (<10)	ND (<5)	ND (<10)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	SSTL	243	13,600	22,000	191	1,000,000,000	208	189	187	74.3
MW-103	Maximum Detected Concentration	ND (<5)	72	ND (<10)	21.0	ND (<10)	ND (<5)	ND (<5)	ND (<5)	29
	SSTL	311	12,500	52,200	224	1,000,000,000	126	222	220	86.7
MW-107	Maximum Detected Concentration	ND (<5)	32	ND (<10)	ND (<5)	ND (<10)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	SSTL	71.6	1,650	1,390	69.2	8,340	70.1	69.1	69.1	27.6
MW-102	Maximum Detected Concentration	ND (<5)	130	ND (<10)	7.7	18	ND (<5)	ND (<5)	ND (<5)	ND (<5)
	SSTL	226	11,600	8,600	181	1,000,000,000	196	180	179	70.9

well. Samples will be contained within laboratory-supplied glassware containing the appropriate preservative for the specified analysis and refrigerated immediately.

Quality Assurance/Quality Control Procedures

All samples will be appropriately labeled and documented under a chain-of-custody, and field logs will be prepared for each day's sampling at the site. The samples will be transported with one trip blank to the DEP-certified laboratory. In addition, one blind duplicate and one quality assurance/quality control (QA/QC) field blank will be collected. The duplicate will be chosen at random and labeled MW-111. The field blank will be collected by pouring deionized water supplied by the laboratory through a dedicated polyethylene bailer prior to use in the wells. Analysis of VOCs and SVOCs will be completed using standard EPA Methods 8260 and 8270, respectively. The duplicate will be subjected to the same analysis as the monitoring wells, while blanks will only be analyzed for VOCs and SVOCs.

Analysis Parameters

All groundwater samples will be analyzed for the parameters listed in Permit Condition IV-C-2 as well as parameters which affect the in-situ biodegradation process. Parameters which will be analyzed in the field include dissolved oxygen, pH, and conductivity. A West Virginia licensed laboratory will analyze for nitrate, ferrous iron, sulfate, and methane in addition to analysis for VOCs using EPA Method 8260, SVOCs using EPA Method 8270, dissolved and total lead, and TOC. A table of sample media, analytical parameters, and blanks is presented as Table 12.

Duration of Sampling

The duration of the sampling will be determined based on the concentration stability of the dissolved COC's and the protection of the identified receptors following the application of the bio-amendments. Sampling will continue until the concentrations of dissolved COC's at all monitoring wells remain below the SSTL's outlined in Table 13 for six (6) consecutive samplings (three consecutive years). Six sampling events over three years will yield sufficient data to demonstrate the continued compliance of COC concentrations with seasonal fluctuations in the subsurface hydrogeology. The methodologies used to derive the SSTL's outlined in Table 13 have been detailed in previous sections within this report.

Table 12

Quality Distribution, Inc.
Institute, West Virginia
In-Situ Biodegredation Groundwater Sampling Parameters
Permit Number: WVR000001719
SAIC Project 01-1633-00-3973-207

	Conductivity (Field Measure)	pH (Field Measure)	Dissolved Oxygen (Field Measure)	Nitrate (EPA 353.2)	Ferrous Iron (Std. Meth 3500-Fe D Mod.)	Sulfate (EPA 300.0)	Methane (Standard Method)	TOC (EPA SW 9060M)	VOC's (SW 8260)	SVOC's (SW 8270)	Total Lead (EPA 7421)	Dissolved Lead (EPA 7421)
MW-101	X	X	X	X	X	X	X	X	X	X	X	X
MW-102	X	X	X	X	X	X	X	X	X	X	X	X
MW-103	X	X	X	X	X	X	X	X	X	X	X	X
MW-104	X	X	X	X	X	X	X	X	X	X	X	X
MW-105	X	X	X	X	X	X	X	X	X	X	X	X
MW-106	X	X	X	X	X	X	X	X	X	X	X	X
MW-107	X	X	X	X	X	X	X	X	X	X	X	X
MW-108	X	X	X	X	X	X	X	X	X	X	X	X
MW-109	X	X	X	X	X	X	X	X	X	X	X	X
MW-110	X	X	X	X	X	X	X	X	X	X	X	X
Trip Blank									X	X		
Blind Duplicate (MW-111)	X	X	X	X	X	X	X	X	X	X	X	X
Field Blank									X	X		
Total Number of Samples	11	11	11	11	11	11	11	11	13	13	11	11

Table 13

Quality Distribution Facility- Institute, WV
SSTL Compliance Table
Permit Number: WVR000001719

All units are in micrograms per liter (ug/l)

Monitoring Well	Benzene	Chlorobenzene	1,4-Dichlorobenzene	1,2-Dichloroethane	bis (2-ethylhexyl) phthalate	Tetrachloroethene	1,1,2-Trichloroethane	Trichloroethene	Vinyl Chloride
MW-101	20,000	200,000	145,000	24,000	343	70,000	77,000	52,000	110
MW-102	226	11,600	8,800	181	343	196	180	179	70.9
MW-103	311	12,500	52,200	224	343	126	222	220	86.7
MW-104	20,000	200,000	145,000	24,000	343	70,000	77,000	52,000	110
MW-105	20,000	200,000	145,000	24,000	343	70,000	77,000	52,000	110
MW-106	20,000	200,000	145,000	24,000	343	70,000	77,000	52,000	110
MW-107	71.6	1,660	1,390	69.2	343	70.1	69.1	69.1	27.6
MW-108	243	13,600	22,000	191	343	208	189	187	74.3
MW-109	299	22,600	45,300	219	343	245	216	214	84.7
MW-110	20,000	200,000	145,000	24,000	343	70,000	77,000	52,000	110

Should concentrations of any COC in any of the monitoring wells exceed the SSTL's for three consecutive samplings, the remedial workplan will be revised to evaluate the trend and potential for anomalous results. If deemed necessary, additionally remedial methods may be proposed to reduce concentrations to below the SSTL. Prior to completing the change in methods, a permit modification will be completed and submitted to DEP.